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Primary Vaginal Cancer: Irradiation Management and End-Results¹

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PRIMARY CANCER of the vagina can be cured by irradiation in a relatively high percentage of cases. This is substantiated in the present report of five-year end-results for 135 definitely primary cases treated at the Roswell Park Memorial Institute during the years 1919-49. Histologically, the diagnoses were as follows: squamous-cell carcinoma (131 cases), adenocarcinoma (1 case), and myosarcoma (3 cases).

The average age of the patients at the time of admission was 57.4 years. Four were under thirty years (1 thirteen years) and 19 over seventy years of age.

Although any segment of the vagina may be involved, the most common site is the upper posterior wall (46 per cent of this series).

Clinically, the cases have been classified as follows:

Stage I (79 cases): The lesion is limited to the vagina or the immediate paravaginal tissue. It may secondarily involve the face of the cervix, but not the mucosquamous junction.

Stage II (45 cases): The lesion (*a*) has extended beyond the immediate paravaginal tissues, (*b*) has invaded the urethra, bladder, rectum, or vulva, or (*c*) has metastasized to the regional lymph nodes or outside of the pelvis, etc.

Stage III (11 cases): The lesion has had definitive treatment before admission of the patient to this Institute.

Five patients who did not receive any definitive treatment after admission are not included in the statistics of this paper. They either did not return for treatment or were terminal when first seen.

TREATMENT

Contrary to the view of Paterson and Tod (1), who wrote that "x-ray treatment is never indicated for cancer of the vagina," our experience leads us to believe that x-radiation should be combined with radium or radon in many patients in order that beneficial results may be achieved.

Any consideration of technic must include the fact that the vagina borders closely on the bladder and rectum. With the most skillful irradiation, it is usually impossible to prevent acute reactions in either of these organs, but by the judicious selection of radiation quality and volume dose it may be possible to minimize more serious late complications. Among 164 cases followed at this Institute up to 1954, there have been 6 late rectal complications (ulcer), 1 late bladder reaction (ulcer), 4 rectovaginal fistulas, and 2 vesicovaginal fistulas. Radiation was responsible for all except the 2 vesicovaginal and 2 of

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the rectovaginal fistulas, which were attributable directly to the cancer itself.

Often radium applied against the lesion by means of cavity or surface applicators of Duraluminum, sponge rubber, plastics, etc., will suffice if used with the proper physical factors necessary to deliver a cancerocidal dose throughout the cancer site. The same precept holds for interstitial radium. Failures may not always be due to the amount of radiation applied, but rather to the inaccurate coverage of the cancer site or an error in estimating the extension of the cancer to the regional lymphatics and neighboring tissue bed. Small vaginal lesions, of course, are much easier to treat by local radium technics than are larger ones. Also, lesions in or near the vault of the vagina are sometimes well managed by an endocervical type of radium application in addition to interstitial radiation. Proper packing of the vagina should always be done in an effort to displace the normal structures a maximum distance from the radium source.

The fear of fistula should not deter the therapist from attempting to destroy the cancer, providing all scientific and rational precautions are taken to minimize such a sequela. These would include (a) homogeneous tumor-site dosage—distribution of radium dose is best achieved by utilization of the physical rules of Quimby (2) or the Manchester system (3); (b) proper protraction of the dose; (c) minimal trauma from the radium applicator or instrumentation; (d) careful medical and nursing care to minimize local infection.

X-ray treatment, when employed, is usually given through converging pelvic ports, with as hard a quality and as many ports of sufficient size, angulation, and focal skin distance as are necessary to deliver a maximum depth dose to the tumor site while keeping the normal tissue dose to a minimum. Occasionally, a transvaginal route may be used to cover a small posterior vaginal wall lesion. One may also utilize a vulvoperineal approach but, because of poor tolerance of the vulva, this technic is avoided if possible.

All roentgen doses quoted are in tissue roentgens; x-ray treatments are given Monday through Friday.

TECHNIC

Radium Surface Applicators, etc.: Radium sources should be of adequate active length and spaced at the proper distance from the surface of the cancer so that the isodose planes will allow sufficient penetration to the deepest cell of the cancer in order to create a cancerocidal effect. The dose is commonly understood to be 6,000–8,000 r within five to seven days, depending upon the volume of tissue treated and the type of applicator. At this Institute, the following technic has been frequently used: a 50-mg. cell of 12.5 mm. active length and 15.5 mm. actual length, with 1.0 mm. platinum filtration, is placed in the center of a plastic applicator having an overall diameter of 20.0 mm. and overall length of 35.0 mm. These applicators may be used singly, in tandem, or side by side. The roentgens per milligram per hour at any distance, in any direction, may be readily determined by iso-intensity curves. Adequate depth intensities for localized lesions, within practical time limits, may be possible with such radium applicators. They have proved most successful when used as an adjunct to externally applied x-rays.

Lesions in the upper end of the vagina may sometimes be adequately irradiated by a conventional endocervical radium applicator. Tandem tubes consisting of two or three 10- or 15-mg. sources with a cross-attachment of one or two 15-mg. sources at the face of the cervix will give the contiguous vaginal tissue very good radiation coverage. A fornix attachment holding 15 to 25 mg. of radium will raise the dose in the paracervical triangle much higher. Since the behavior of these upper vaginal lesions is similar to that of a primary cervical cancer, such fixed radium sources assure not only accuracy but good isodose planes out to the peripheral tissues, possibly already the seat of extension or metastasis. The dose with this particular ap-

applicator would be similar to that used in Stage I cancer of the cervix. At this Institute, it is customary to give a roentgen dose of 7,000 to 8,000 r to a point 2 cm. lateral to the center of the tandem, within approximately five to six days. From isodose charts for different radium loadings, the amount of radiation reaching an upper vaginal tumor site can easily be determined. Doses from special or unusual applicators can always be figured from the proper dosage charts. Supplemental radon seeds or radium needles may be inserted into the tumor site or treatment field to bring the minimal tumor dose to the proper level.

Special vaginal applicators made of plastic, dental compound, sponge rubber, etc., have been used. These may be loaded with multiple linear sources of radium ranging from 10 to 50 mg. The loading must be done accurately to insure proper coverage of the tumor site. Such special applicators may be employed continuously or in a fractionated technic. Higher total tumor doses may be attained by means of fractionation, although the multiple insertions of the applicator in a patient with extensive vaginal carcinoma might prove impractical because of the need of anesthesia, etc.

Radium Needles: With suitable experience, radium needles may prove very efficient. A single plane implant will fit a lesion confined to one side of the mid-line of the vagina. If the cancer involves both sides of the mid-line, a two-plane implant is indicated. When there is deep permeation into the paravaginal tissue, a third plane or a volume implant might be necessary. It is suggested that these latter two technics be carried out only by an expert. Otherwise, roentgen irradiation with or without radon should be used for extensive disease.

Radon Seeds: Radon seeds were used more frequently years ago than today. As with radium needles, experience is required to achieve a homogeneous pattern. Radon seeds are sometimes much easier to use than needles, especially in upper vagi-

nal lesions. They are excellent in residual tumor sites where very local but intense radiation may be needed. Employed alone they have given poor results at this Institute, because of the inadequate "coverage" of the tumor site. As with radium needles, care must be exercised to avoid trauma to neighboring organs.

Transvaginal Roentgen Irradiation: A small posterior-wall cancer may be treated by x-rays applied through a treatment cone if it is possible to include an adequate tissue field in the distal end of the cone. The selection of quality will depend upon the thickness of the lesion. The usual quality would be h.v.l. 1.4 mm. Al (100 kvp) or h.v.l. 0.5 mm. Cu (140 kvp). The method has limitations mainly because most vaginal lesions will not fit a treatment cone and the daily placement of the cone in an accurate position is sometimes difficult, due to kraurosis or senile vaginitis. The procedure can be painful or discomforting, especially after the early radiation reaction begins to appear. For this reason, some therapists prefer to deliver the total tumor dose within a short time, e.g., eight days, so that the treatment is completed before the intense reaction occurs. It has been our custom to give not more than 500 r per day to the surface of the lesion. This increment may be repeated daily until a total surface dose of 5,000 to 6,000 r is reached.

External Roentgen Therapy: It is necessary to use external pelvic ports in order to apply homogeneous radiation throughout the true pelvis. This technic is indicated in (a) the large extensive lesions where radium or radon could not be efficacious and (b) in certain postoperative cases. In conjunction with radium or radon, it is useful for those small lesions in which induration makes the examiner suspicious of intrapelvic permeation.

In extensive bulky vaginal cancers with intrapelvic spread, spectacular results may sometimes reward the therapist for his patience and confidence. Many of these lesions are radiosensitive and may respond favorably to volume tissue doses well within tolerance range, 5,000 to 6,000 r

within thirty-five to forty-five days (see Fig. 1).

Such dosage may be given through four to six multiple converging ports. The size, angulation, and separation of the ports depend upon the extent of the tumor. The technic is best determined by plotting

reservations on this point. This is particularly true for lesions which are infiltrating or of such induration and extent as to indicate definite or probable extension. Primary cancers in the upper third of the vagina have a lymphatic spread similar to carcinoma of the cervix. It is therefore

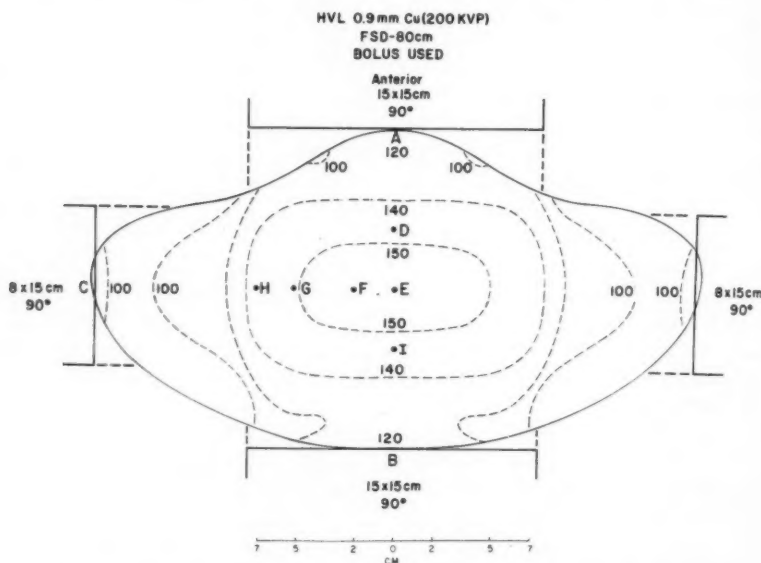


Fig. 1. Diagram of x-ray technic used for a 50-year-old patient who had an extensive occlusive vaginal cancer infiltrating both broad ligaments. She received 175 r to all ports daily for 23 cycles (thirty-five days); average tumor dose 6,000 r. The patient is alive without clinical or cytological evidence of cancer after more than five years.

isodose curves on a life-sized diagram of the patient. In this way, the most favorable arrangement of ports, etc., may be achieved. The radiologist should utilize as hard a beam and as long a focal skin distance as are available and practical. Excellent results have been obtained even with h.v.l. 0.9 mm. Cu when multiple-port daily fractionation is carried out (Fig. 1). Better depth-to-surface-dose differentials will result with h.v.l. 2.5 mm. Cu and up. This Institute today usually employs a h.v.l. of 5.0 mm. Cu or higher for these cases.

Roentgen Therapy and Radium Combined: Although radium application may in some instances appear well able to control a vaginal cancer, one may have valid mental

often better to combine a local attack by radium with an external attack by x-rays. This will permit greater tissue coverage and may result in control of more cases. The combined total dosage should be accurately planned and executed. In most cases treated in this way the x-ray dose is delivered through multiple converging ports. The tumor dose from this source is usually 5,000 to 6,000 r within thirty-five to forty-five days. The radium applicator is used immediately at the end of the x-ray regime. The dose is customarily estimated for a point 2 cm. from the center of the source and would average between 2,000 and 3,500 r, depending upon the total x-ray dose, the time period, and the type and location of the radium

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source. If an endocervical type of applicator (e.g., 3×15 mg. in tandem, plus 2×15 mg. at the face of the cervix) were used, it might be possible to deliver a higher 2-cm. distance dose in the fornix and paracervical triangle area than would be feasible in other vaginal sites (e.g., mid

quela of fistula. With the best of controls, there may be a slim margin of safety, in some tumor sites, between a permanent cancerocidal effect and an irreparable necrotizing effect in a contiguous or neighboring normal organ. When one is faced with an advanced lesion with an apparently

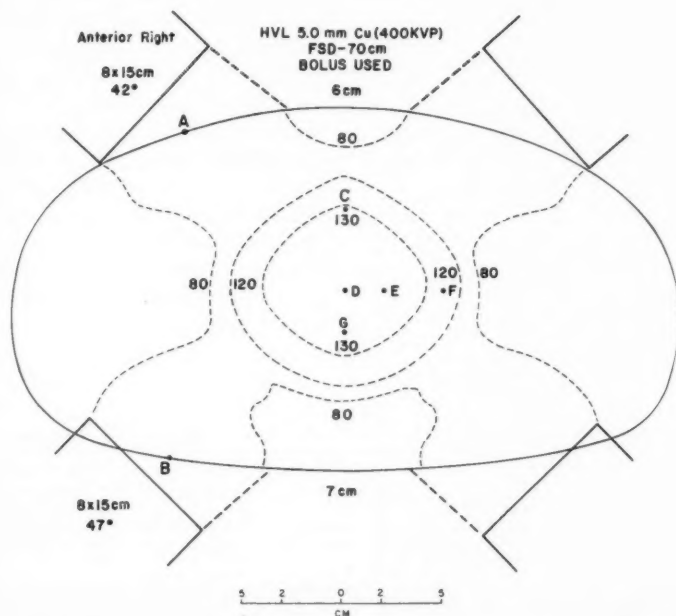


Fig. 2. Diagram of x-ray technic used for a 68-year-old patient with an ulcerated lesion of the anterior wall of the lower third of the vagina, 2×3 cm. She received 175 r to all ports daily for 22 cycles (thirty-four days); average tumor dose 5,000 r. Radium (50 mg.) in a plastic applicator (8.0 mm. wall) was applied one day after the x-ray regime for a dose at 2 cm. of 2,300 r. The patient is alive without clinical or cytological evidence of cancer after more than six years.

or lower vagina) if 50 to 100 mg. sources in plastic applicators (wall thickness 0.8 mm.) were placed against the vaginorectal or vaginovesical septa (Fig. 2).

In combining x-ray and radium modalities, one should always be careful not to overtreat, as the writer has done on occasion, as illustrated by Figure 3. Here the supplemental dose from radium was inadvertently high due to an inexcusable error in withdrawal timing. The probability exists that in this case a smaller total dose would have accomplished an apparent long-term cure without the se-

grave prognosis, enthusiasm to push treatment to a high tumor dose level is sometimes a regrettable reality. There are fairly well defined limits in time-dose relationship beyond which "extra roentgens" may invite poorer results.

Vulvoperineal Ports in Conjunction with Radium or Radon: Vulvoperineal ports are avoided as much as possible because this region does not tolerate radiation well. It is sometimes necessary, however, to utilize such an approach for lesions in the lower third of the vagina, of a size and position not suitable for a direct trans-

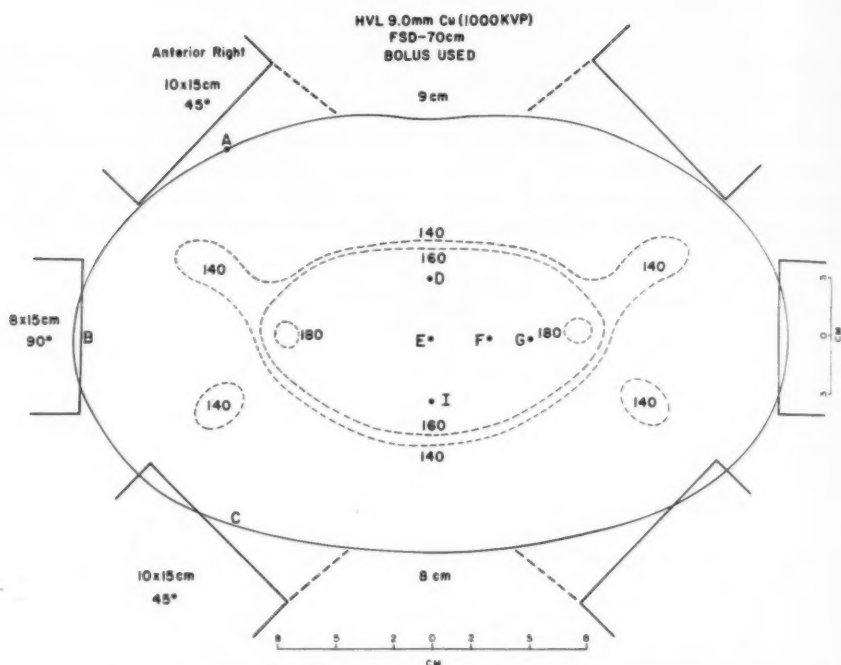


Fig. 3. Diagram of the x-ray technic used for a 51-year-old patient with an extensive ulcerated lesion of the entire vaginal vault, with nodular infiltration of both sides of the pelvic floor (complete hysterectomy eight years previously for uterine fibroid). She received 125 r to all ports daily for 30 cycles (forty-three days); average tumor dose 6,500 r. Four days later, radium (50 mg.) in a plastic applicator (8.0 mm. wall) was applied to the vaginal vault for a dose at 2 cm. of 5,600 r. After five months, a vaginorectal fistula developed. A colostomy was done. The patient is alive without clinical or cytological evidence of cancer after more than eight years.

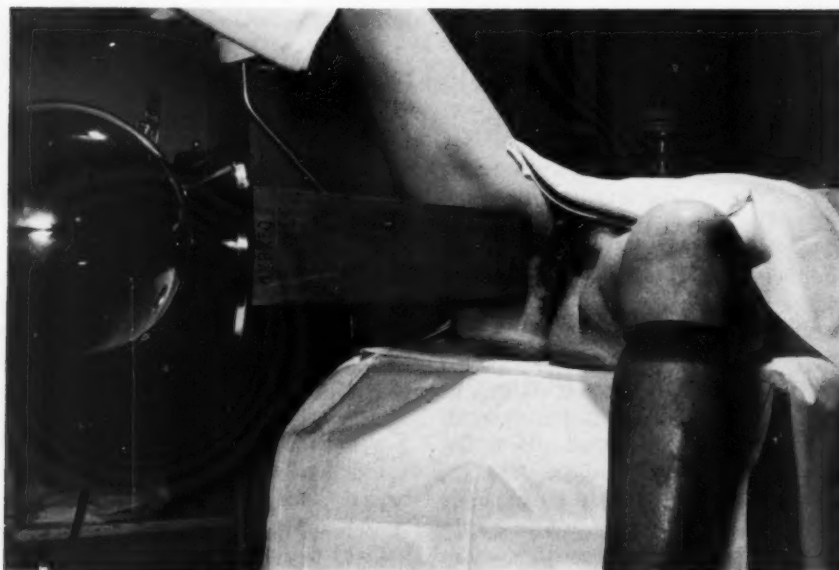


Fig. 4. Treatment position for a right vulvoperineal port, as described in text and Figure 7.

vaginal treatment cone or radium or radon alone, where the treatment field can be adequately covered by a skin portal of 6×8 cm. or less. The external skin surface dose should be kept within the upper range of tolerance (approximately 4,500 r within about nineteen to twenty-two days), and the régime supplemented by the local radium applicator, radium needles or radon seeds at the cancer site. One single port, approximating the vulvoperineal tissue, or a cross-fire technic may be used. For the latter, both right and left vulvar ports may be angulated toward the center line at an angle of approximately 45 to 55° . These ports are obtained with the patient in the lithotomy position and the lower extremities in extreme abduction (Fig. 4). The medial edge of the beam should be at the mid-line of the vulva. This means that the lateral edge of the treatment cone is touching the upper thigh area. This arrangement necessitates a large air space between the bottom of the cone and the skin of the vulva. Should bolus be used in this space, the tissue surface dose would correspond to water or Masonite phantom isodose values at that particular depth. Should no bolus be used, then the surface dose is governed by the inverse-square law, and any depth tissue point must be estimated by the use of special isodose curves drawn for that particular angle and air spacing (Fig. 5). When it is important to obtain optimum depth penetration consistent with known isodose distortion, it is better not to use bolus. Both the vulvar ports may be augmented by an anterior pelvic or suprapubic port which is angulated slightly caudally so that it may cross-fire the vaginal tissue (Fig. 6).

Although the quality of radiation is elective with this technic, we have found it most convenient to use h.v.l. 0.9 mm. Cu (200 kvp) or 2.5 mm. Cu (250 kvp). A more favorable depth dose may be obtained in some patients with 5.0 mm. Cu h.v.l. (400 kvp) or higher for the suprapubic port.

The focus-skin distance is 50 cm. for the vulvar ports and 50 to 80 cm. for the supra-

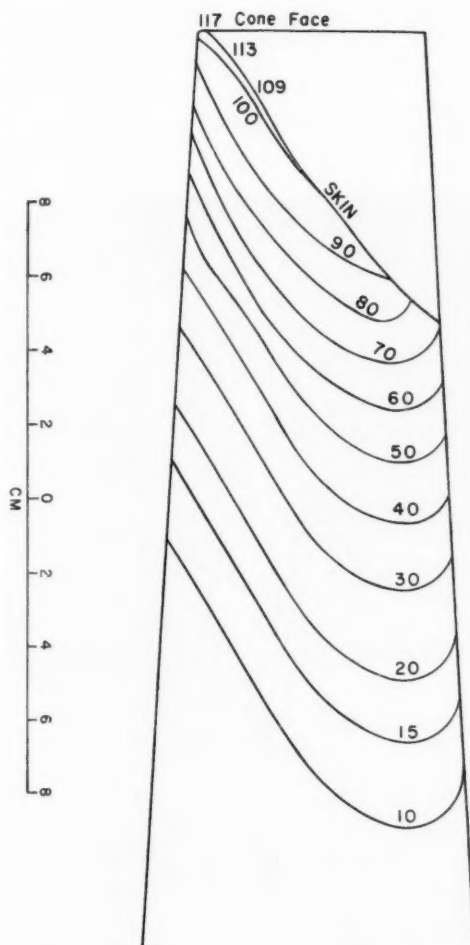


Fig. 5. Distorted isodose curves produced by absence of bolus. Half-value layer 0.9 mm. Cu. Treatment cone size, 6×8 cm. at 50 cm. F.S.D. (see Figure 4).

pubic port. It has been a practice to use increments of 200 to 300 r to all ports daily. This depends upon the percentages of the incident x-ray beams that reach the cancer site as determined by isodose plotting (Figs. 7 and 8; Table I).

The supplemental dose from radium or radon would be such as to bring the total minimal cancer dose from x-rays and radium to 5,000 to 6,000 r within approximately twenty-five to thirty days. This is feasible because of the smaller tissue volume irradiated.

TABLE I: PERCENTAGE CONTRIBUTIONS FROM EACH PORT (FIGS. 7 AND 8)
(Skin increment doses would depend upon desired depth dose increment)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Suprapubic	10	10	32	31	41	38	45	15	10	40	23	60	28	100
Right vulva	75	0	72	5	47	43	20	75	75	64	64	40	40	0
Left vulva	75	94	72	76	47	36	20	75	75	64	64	40	40	0



Fig. 6. Position of treatment cone for an anterior pelvic port used in conjunction with right and left vulvoperineal ports as described in text and in Figure 8.

Should a vaginal lesion be invading the vulva, and particularly if it is extensive, the tumor dose at the introitus level would necessarily have to be higher than 4,500 r if it were not feasible to use supplemental radium or radon. Here, more fractionation of the total x-ray dose would be necessary in order to reach a suitable dosage level, as, for example, 5,000 to 6,000 r within approximately thirty-two to forty days. Extensive lesions which involve vaginal tissue other than the lowest third or the distal end are better handled by the multiple external port technics already described.

END-RESULTS

As stated above, the end-results to be reported here are based upon 135 cases treated at the Roswell Park Memorial Institute during the years 1919-49. All cases were histologically verified. The clinical grouping has been described. When definite proof of extravaginal extension was lacking, the case has been placed by the writer in the earlier clinical stage. In former years, many cases were recorded as Stage II because of the examiner's clinical impression that the base of the bladder or rectum was involved. If such cases, irrespective of their vaginal extent, showed no definite evidence of mucosal invasion, they are considered here as Stage I. As a result, many patients may be erroneously listed as Stage I, because of restricted information. Even though most of these patients died of cancer, which thus influences the end-result in Stage I, their clinical staging does not influence the results for the entire series. Only the Stage III cases (definite treatment before admission, surgical or radiological) which received subsequent treatment at this Institute are included in the statistics. Five patients seen during the years 1919-49 were not treated, due either to their refusal or their terminal condition.

Table II shows the end-results broken down into clinical stages, and Tables III and IV according to the radiation technics employed. From these tables, it may be seen that the absolute five-year cure rate for patients who received all their definitive therapy at the Roswell Park Memorial Institute was 24.2 per cent. The rate for the Stage I cases was 31.6 and for the Stage II cases 11.1 per cent.

Since many of these patients were treated during the years when radiation therapy was very inadequate, it was

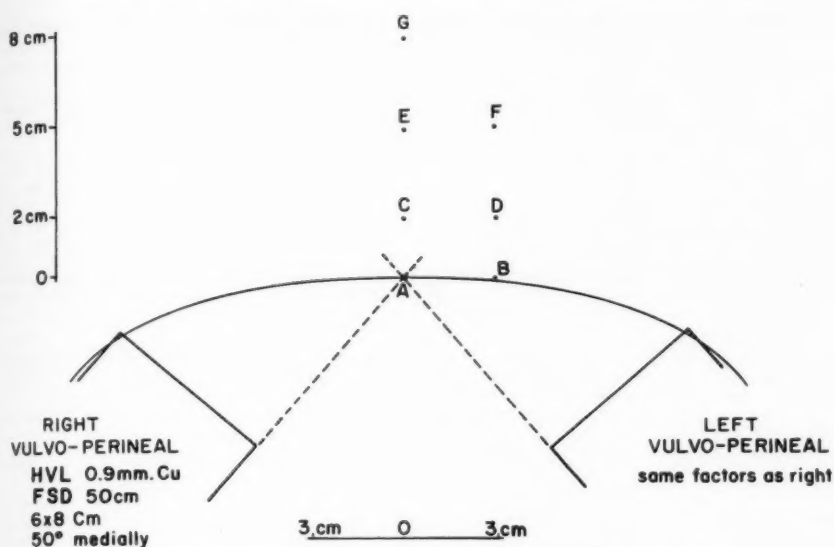


Fig. 7. Diagram of the right and left vulvar ports angulated medially. These two ports are supplemented by an anterior port, as shown in Figure 8. The percentage contributions to the labeled anatomical points are given in Table I.

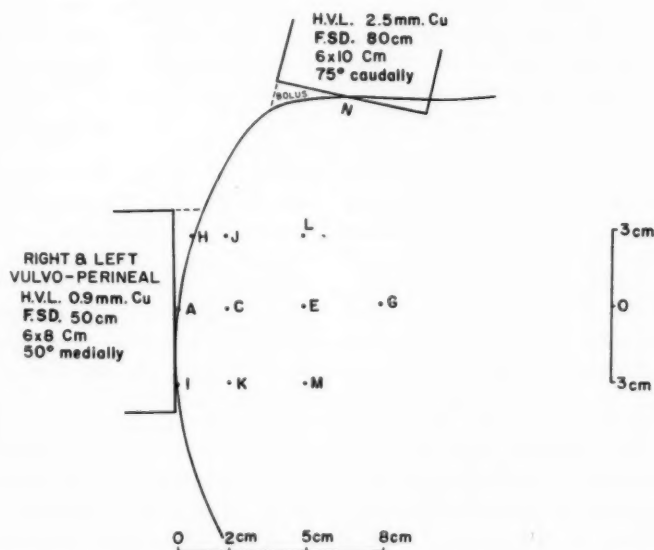


Fig. 8. Diagram of a mid-sagittal section through the pelvis, showing the anterior pelvic port and the crossing border of the medial edges of the right and left vulvar ports. The percentage contributions to the labeled anatomical points may be read in Table I.

thought that a review of the cases treated since 1940 would be of interest. Table V shows the results in the cases treated from 1940 to 1949. In Stage I, 9 out of 13 patients lived over five years without evidence of cancer (69.2 per cent), while

TABLE II: PRIMARY CANCER OF THE VAGINA, ROSWELL PARK MEMORIAL INSTITUTE: FIVE-YEAR END-RESULT ACCORDING TO STAGE, 1919-49

Stage	Number of cases	Lost trace of before five years	Died of other cause before five years	Died of cancer before five years	Lived over five years with cancer	No evidence of cancer after five years
I	79	3	5	45	1	25 (31.6%)
II	45	0	0	39	1	5 (11.1%)
III	11	0	0	5	1	5* (45.5%)
I + II + III	135	3	5	89	3	35 (25.9%)
I + II	124	3	5	84	2	30 (24.2%)

* Stage III: One patient had had radiation therapy before admission; 3 had received surgical treatment before admission; 1 had had cauterization by silver nitrate before admission. All were given supplemental radiation therapy at the Roswell Park Memorial Institute.

TABLE III: PRIMARY CANCER OF THE VAGINA, ROSWELL PARK MEMORIAL INSTITUTE. FIVE-YEAR END-RESULT (NO EVIDENCE OF CANCER) ACCORDING TO METHOD OF TREATMENT (SINGLE MODALITY), 1919-49

Type of Treatment	Number of Cases			No Evidence of Cancer After Five Years		
	Total	Stage I	Stage II	Stage I	Stage II	Total
X-ray	10	7	3	3 (42.9%)	0	3 (30.0%)
Radium applicator	7	4	3	1 (25.0%)	0	1 (14.3%)
Radium needles	1	1	0	1 (100.0%)	0	1 (100.0%)
Radon seeds	3	2	1	1 (50.0%)	0	1 (33.3%)
TOTAL	21	14	7	6 (42.9%)	0	6 (28.6%)

3 died of other causes three years after treatment, free of vaginal cancer (proved in 2 by autopsy). For the Stage II cases, the five-year cure rate was only 23 per cent. In these cases there was extension of the cancer, as explained earlier. The absolute five-year cure rate in these patients who were treated between 1940 and 1949 and who had their first definitive treatment at the Roswell Park Memorial Institute was 46.2 per cent, which is higher than the 24.2 per cent for the entire comparable group (Stage I and II). If one exempts the 3 patients in Stage I who died at an average of three years after treatment for their vaginal cancer but whose deaths were due to other causes with the pelvis free of cancer, the relative cure rate becomes 52.2 per cent for this selected group (Stages I and II) and 90 per cent for Stage I.

It is obvious from these statistics that adequate modern treatment for a primary cancer which is still limited to the vaginal tissues may result in a fairly high cure rate.

A study of the types of radiation employed in the entire series with the cure rate for each type is presented in Tables

III and IV. In many of these cases, the roentgen radiation delivered was only of a "token" nature when used in conjunction with radium or radon. There were 10 patients (7 Stage I; 3 Stage II), however, treated by x-rays alone, and 3 of these (all Stage I) were cured (30 per cent). The end-results in the entire series were almost equal whether a single modality or a combination was used.

In studying the series treated from 1940 to 1949, it was found that of the 9 cured Stage I cases (69.2 per cent), only 1 received local radium treatment alone. One had intensive transvaginal x-ray irradiation (h.v.l. 1.4 mm. Al; 500 r \times 15 treatments); 1 had teleradium therapy to both the anterior and posterior pelvis plus treatment by a radium applicator and radon seeds; 2 were treated by external 400-kvp x-rays (h.v.l. 5.0 mm. Cu) plus local radium surface applicator, and 4 by external 200-kvp x-rays (h.v.l. 0.9 mm. Cu) plus radium surface applicator in 2 and radon seeds in the other 2 patients. In all instances the x-ray therapy was quite intensive. Of the 13 patients in Stage II, 3 lived over five years without clinical evidence of cancer. In 1 of these 3, a cancer involving the vagi-

TABLE IV: PRIMARY CANCER OF THE VAGINA, ROSWELL PARK MEMORIAL INSTITUTE. FIVE-YEAR END-RESULT (NO EVIDENCE OF CANCER) ACCORDING TO METHOD OF TREATMENT (COMBINED MODALITIES), 1919-49

Type of Treatment	Number of Cases			No Evidence of Cancer After Five Years		
	Total	Stage I	Stage II	Stage I	Stage II	Total
X-ray, radium applicator, radium needles, or radon seeds	28	19	9	8 (42.1%)	0	8 (28.6%)
X-ray and radium applicator	35	19	16	5 (26.3%)	3 (18.8%)	8 (22.9%)
X-ray and radium needles	2	1	1	0	1 (100%)	1 (50.0%)
X-ray and radon seeds	33	23	10	6 (26.1%)	0	6 (18.2%)
X-ray and teleradium	1	1	0	0	0	0
Radium applicator and radon seeds	1	1	0	0	0	0
Teleradium, radium applicator, and radon seeds	2	1	1	0	1 (100%)	1 (50.0%)
Teleradium, x-ray, and radium applicator	1	0	1	0	0	0
TOTAL	103	65	38	19 (29.2%)	5 (13.2%)	24 (23.3%)

TABLE V: PRIMARY CANCER OF THE VAGINA, ROSWELL PARK MEMORIAL INSTITUTE. FIVE-YEAR END-RESULT, 1940-49

Stage	Number of cases	Died of other cause before five years	Died of cancer	No evidence of cancer after five years
I	13	3 (av. 3 yr.)	1	9 (69.2%)
II	13	0	10	3 (23.0%)
III*	2	0	2	0
I + II + III	28	3	13	12 (42.9%)
I + II	26	3	11	12 (46.2%)

* Stage III: Cases having had definitive treatment elsewhere before radiation therapy at Roswell Park Memorial Institute.

nal vault and pelvic floor was treated by x-rays (h.v.l. 9.0 mm. Cu) and radium applicator; in another, with involvement of the left vaginal wall and broad ligaments, treatment was by x-rays (h.v.l. 0.9 mm. Cu) and radium needles; in the third, with spread from the right wall of the vagina to the right broad ligament, x-rays (h.v.l. 5.0 mm. Cu) and radium applicator were used. Of the 10 patients in Stage II who died of cancer, 6 had groin metastases, 2 invasion of the rectum, 1 metastases to bone, and 1 invasion of the broad ligament area (this last patient lived eight years).

CONCLUSION

Primary cancer of the vagina would be recognized early if more women would undergo, periodically, a complete physical examination. If the lesion is discovered before it has extended beyond the vagina proper, the radiological end-result is good.

Even though the cancer has extended beyond the vagina itself, intensive radiation will salvage a few cases, often in a spectacular fashion. More effort must be directed toward improving the radiologic technic for these advanced lesions. It may be that harder radiation sources applied by modern instrumentation and directed by enlightened precepts of radiobiological effects will bring about better end-results. The results show that x-ray therapy plays a very important part in the radiologic management of primary vaginal cancer.

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SUMMARIO IN INTERLINGUA

Cancere Vaginal Primari: Su Tractamento per Irradiation e le Resultatos Final

Le facto que cancro primari del vagina pote esser curate per irradiation in un relativemente alte procentage del casos es indicate per le reporto de 135 casos tractate al Hospital Memorial Roswell Park (Rochester, New York) inter 1919 e 1949. Le sequente methodos de tractamento esseva usate, sol o in varie combinationes: Application superficial de radium, implantation de agulias de radium, insemination de radon, roentgeno-irradiation transvaginal, e roentgenotherapia externe. Le technicas usate es describite.

Secundo lor stadios clinic le casos esseva classificabile in le sequente gruppos: Stadio I: Lesion limitate al vagina o a tessuti immediatamente paravaginal; nulle invasion del junction mucosquamose. Stadio II: (a) Extension in ultra del tessuti immediatamente paravaginal; (b) invasion de urethra, vesica, recto, o vulva; (c) metastase a nodos lymphatic regional o

foras del pelve. Stadio III: Casos previeamente tractate in altere hospitales.

Le proportion absolute de curas quinquenne inter le patientes qui recipeva lor complete curso therapeutic al Instituto Memorial Roswell Park—i.e. le patientes de Stadio I e Stadio II—amontava a 24,2 pro cento. Le proportion inter patientes de Stadio I esseva 31,6 pro cento e de Stadio II 11,1 pro cento. Plus alte proportiones de curation valeva pro le casos tractate post 1940 (probabilmente con plus adequate dosages). Pro Stadios I e II in combination, iste proportion amontava a 46,2 pro cento; pro Stadio I, a 69,2 pro cento; e pro Stadio II, a 23 pro cento.

Un detaliation del resultatos quinquenne secundo le modos de tractamento es presentate in forma tabular. Isto justifica le conclusion que le roentgeno-therapia ha un rolo importante in le tractamento de cancro vaginal primari.



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Contrast Examination of the Larynx and Pharynx¹

WILLIAM E. POWERS, M.D., HARRY H. McGEE, JR., M.D., and WILLIAM B. SEAMAN, M.D.

THE RADIOLOGIST is often frustrated in attempting to record on film his fluoroscopic observations of the pharynx. The rapidity of passage of contrast substances causes great difficulty in recording changes of even a gross degree, much less those too fine to be seen fluoroscopically. The techniques utilizing the contrast of intraluminal air and the soft tissues of the region are often inadequate for the demonstration of minor alterations. The persistence of contrast substance within the pharynx and larynx of those patients anesthetized for bronchography suggested to us the use of anesthesia and a contrast material for the examination of these structures. We have accordingly utilized topical anesthesia and contrast media for study of the normal and abnormal anatomy and physiology of the larynx and pharynx.

HISTORY

Jackson was apparently the first to report the use of contrast substances within the bronchial tree, describing insufflation with bismuth in 1918 (17). He also employed Lipiodol as a contrast substance in the larynx and pharynx (18). There are many other scattered references to contrast examination of these organs, particularly in the foreign literature (3, 6, 7, 10, 15, 16, 20, 21, 22, 25), this technic having been applied to the study of tumors and in physiological and anatomical investigations. Brauer (7) recently combined laminagraphy and a contrast substance for the examination of the larynx. In view of the ease and simplicity of the procedure, it is surprising that its use has been so limited. This neglect may result, in part, from the lack of a satisfactory medium and failure to understand the normal and abnormal physiology of the larynx and pharynx.

TECHNICS

The procedure for the anesthetization of the larynx and the introduction of a radiopaque medium is essentially that used in bronchography. The patient is given premedication consisting of 0.09 gm. Nembutal and 0.0004 gm. atropine one hour prior to examination. The clinical history is elicited, with special questioning in regard to drug sensitivity. The posterior oropharynx is anesthetized with 5 per cent Cyclaine. Anteroposterior and lateral soft-tissue films of the neck are obtained. The hypopharynx and larynx are then anesthetized by spraying with 2 c.c. of 5 per cent Cyclaine. Prior to the introduction of the contrast medium, the patient is examined fluoroscopically and instructed as to the following procedures: quiet inspiration through the nose with the mouth closed, phonating "Eeeee," modified Valsalva maneuver with the glottis open and the lips and nose closed, and a true Valsalva maneuver with a closed glottis. He is cautioned not to swallow or cough after the introduction of the radiopaque medium.

A syringe attached to a curved metal cannula is used to administer the contrast substance. Five to 10 c.c. are dripped slowly over the back of the tongue intermittently during inspiration. The medium fills the valleculae and the pyriform sinuses and coats the larynx.

Postero-anterior and lateral spot-films are exposed while the patient performs the maneuvers mentioned above. Occasionally, laminagrams are taken but these have not contributed any additional information. High kilovoltage is employed to decrease the exposure time.

Lipiodol, Dionosil in aqueous suspension, and Dionosil Oily, have been used as

¹ From the Edward Mallinckrodt Institute of Radiology, Department of Radiology, Washington University School of Medicine, Saint Louis, Mo. Presented as an Exhibit at the Forty-Second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2-7, 1956. Accepted for publication in June 1956.

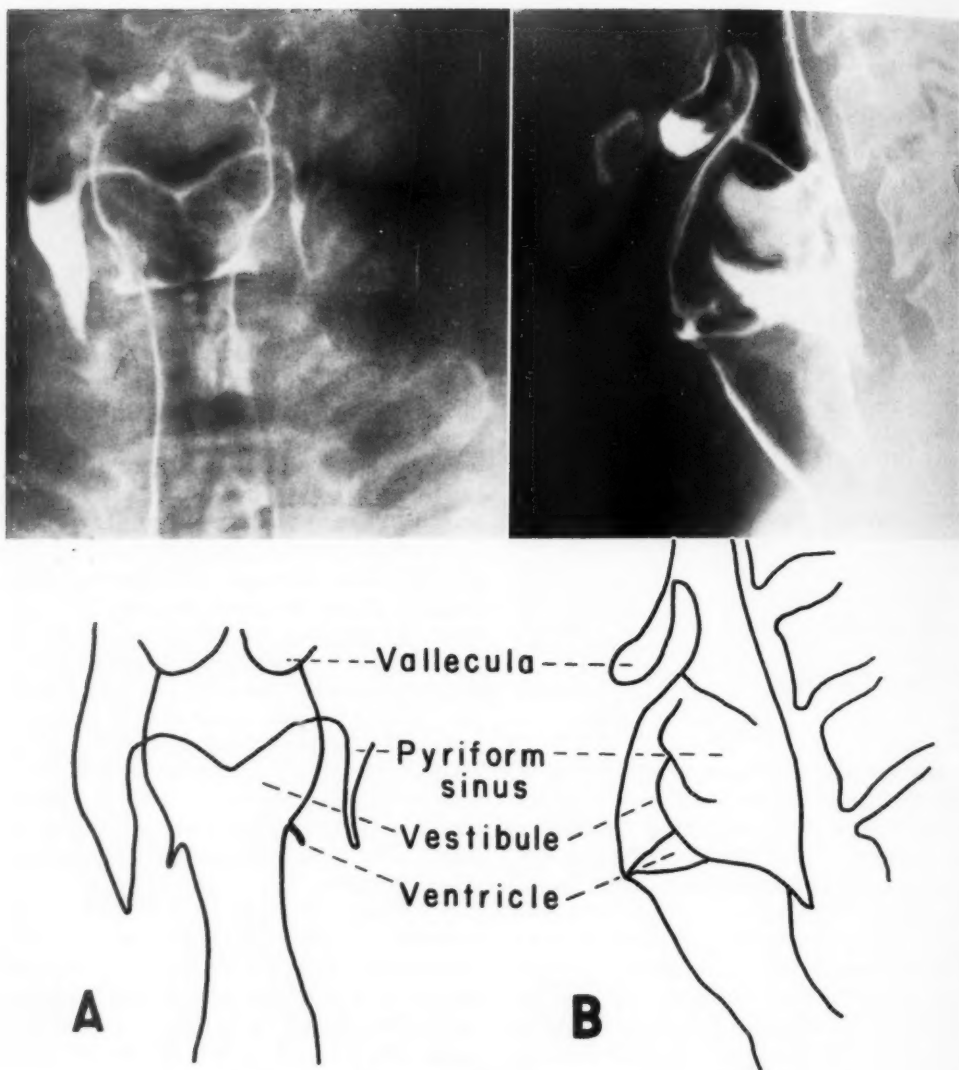


Fig. 1. Normal Laryngogram: Inspiration

A. Frontal view. The walls of the laryngeal vestibule are well defined. The false cords are barely evident, and the true cords are in complete abduction, retracted superiorly to lie against the inferior surface of the false cords, thus almost completely obliterating the laryngeal ventricles.

B. Lateral view. The epiglottis is erect and its laryngeal surface is well covered with contrast substance. There is a contrast coating of the posterior pharyngeal wall, and the ventricles have a small amount of radiopaque material within them. The pyriform sinuses pool the contrast substance and obscure the arytenoids and, because of superimposition, obscure each other. The subglottic area is well outlined, with a normal indentation posteriorly due to the cricoid cartilage. The laryngeal vestibule assumes an angle of about 30° with the trachea. There is a soft-tissue space between the posterior border of the thyroid cartilage and the anterior border of the trachea which usually measures less than 5 mm.

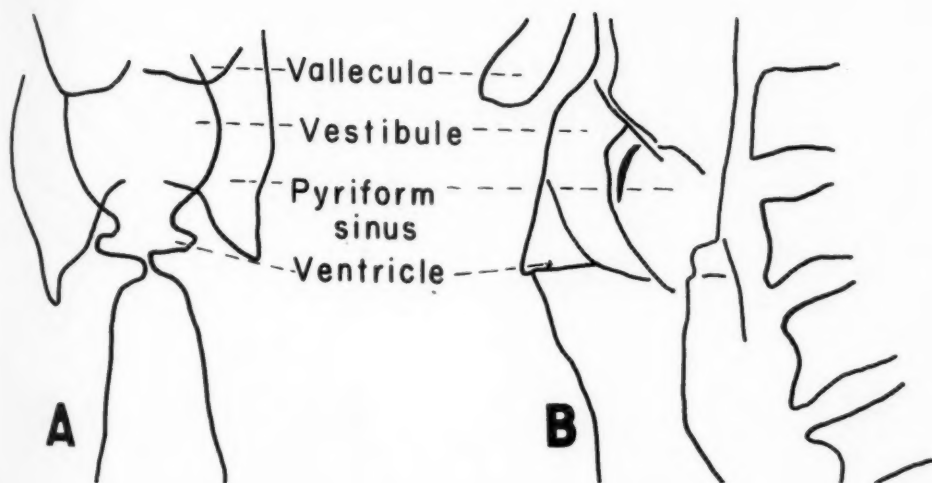
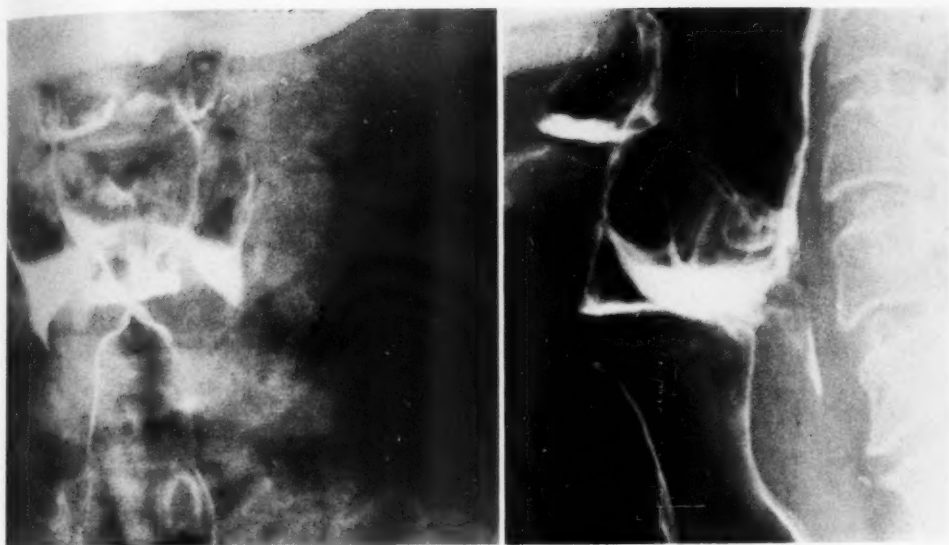


Fig. 2. Normal Laryngogram: Phonation

A. Frontal view. The vestibule narrows inferiorly with bilaterally symmetrical bulges representing the false cords. The true cords oppose each other in the mid-line, with their superior surfaces aligned horizontally and their inferior surfaces forming a sharp subglottic concavity. The laryngeal ventricles are clearly demonstrated during this phase.

B. Lateral view. The hyoid and epiglottis are pulled forward, with elevation of the anterior portion of the larynx, causing the laryngeal vestibule to become almost parallel with the trachea and pharynx. The vestibule is widened and the arytenoids are still somewhat obscured by overlying contrast substance within the pyriform sinuses.

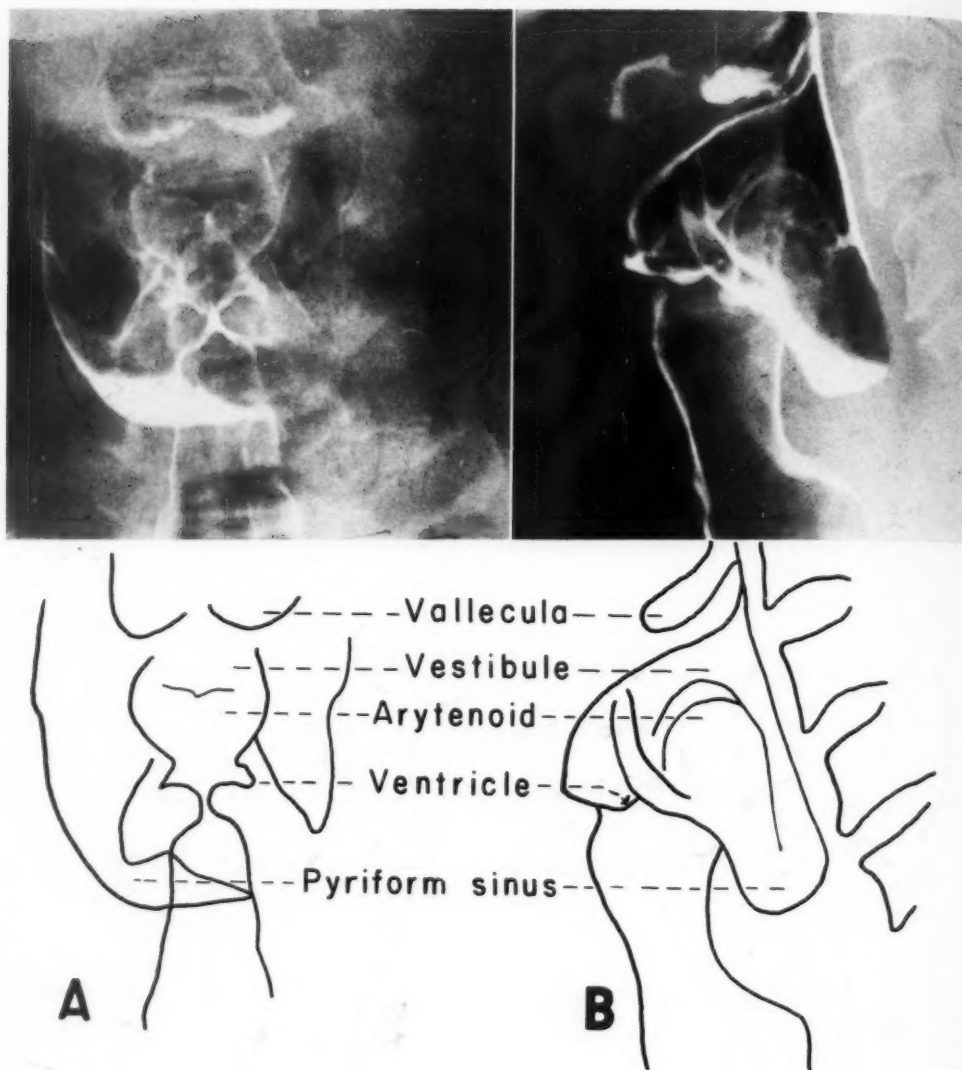


Fig. 3. Normal Laryngogram: Modified Valsalva Maneuver

A. Frontal view. The pyriform sinuses are considerably dilated. The laryngeal vestibule is narrowed inferiorly and the true and false cords assume a position similar to that seen in phonation, except that the true cords are slightly thicker and the ventricles are minimally dilated. In the subglottic region there is symmetrical concavity.

B. Lateral view. The hyoid and anterior larynx are again elevated, but the upper epiglottis is tipped posteriorly rather than taking a vertical position. The laryngeal vestibule now assumes a 45° angulation to the trachea and hypopharynx. The pyriform sinuses are dilated and allow a clear view of the arytenoids.

contrast media. A uniform coating of the structures to be studied has been obtained with Dionosil. With Lipiodol, the coating is irregular. The more uniform distribution of Dionosil Oily, coupled with its rapid

removal from the respiratory tract, has made this the medium of choice.

NORMAL LARYNGOGRAM

We have utilized the above technics to

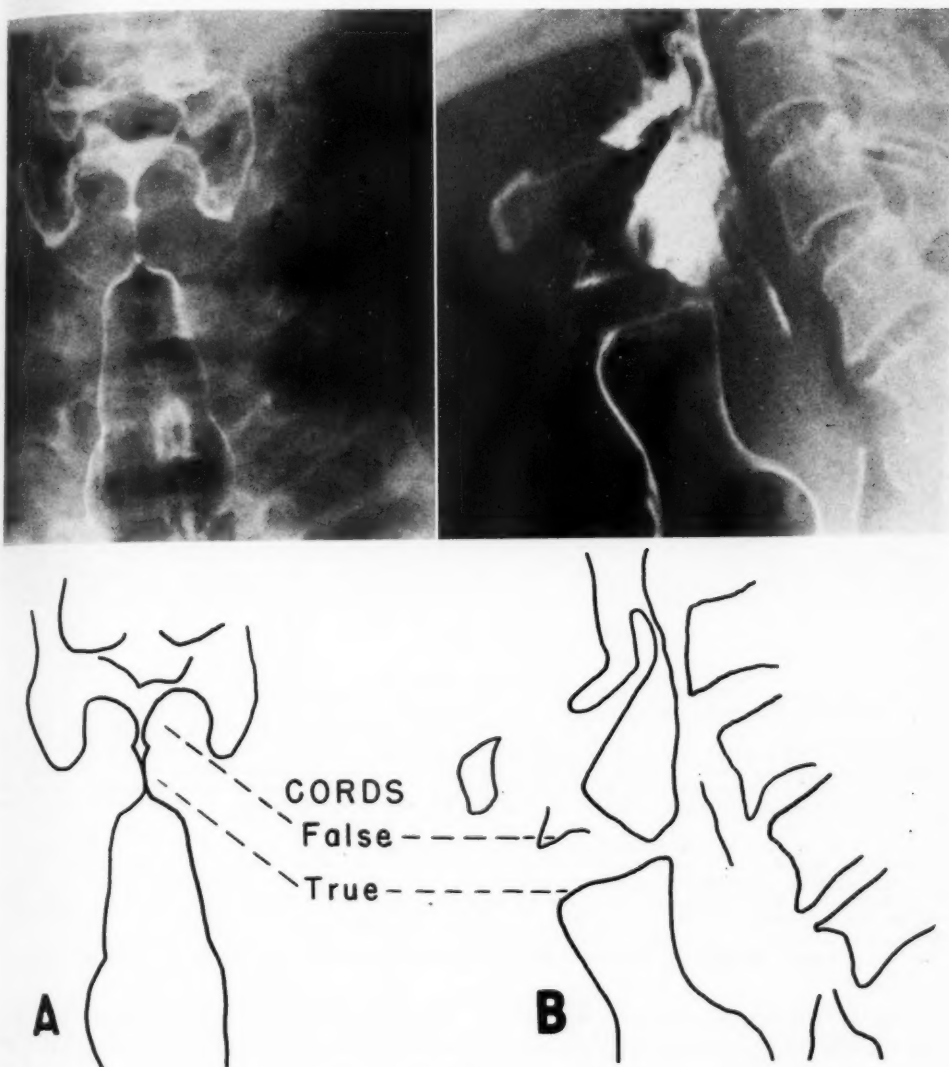


Fig. 4. Normal Laryngogram: Valsalva Maneuver

A. Frontal view. The pyriform sinuses are shortened in vertical height. Approximation of the epiglottis and arytenoids and closure of both true and false cords, with thickening, cause complete obliteration of the vestibule. The true and false cords are of greater thickness at this time than in any other maneuver.

B. Lateral view. The anterior and posterior walls of the pyriform sinuses are closely approximated and the laryngeal vestibule is closed by the posterior position of the epiglottis and elevation of the arytenoids. The laryngeal ventricle, which is seen as a thin linear density, is separated from the trachea by a soft-tissue mass that represents the thickened true cord.

study the anatomy and function of the hypopharynx and larynx in 25 normal subjects.

During quiet inspiration through the nose, with the mouth closed, the larynx and hypopharynx are at rest; the larynx is

open, the diameter of its lumen being only slightly less than the diameter of the trachea below the glottis (Fig. 1).

On phonation, the larynx is elevated and there is a grossly evident change in the relation of the epiglottis and vestibule with

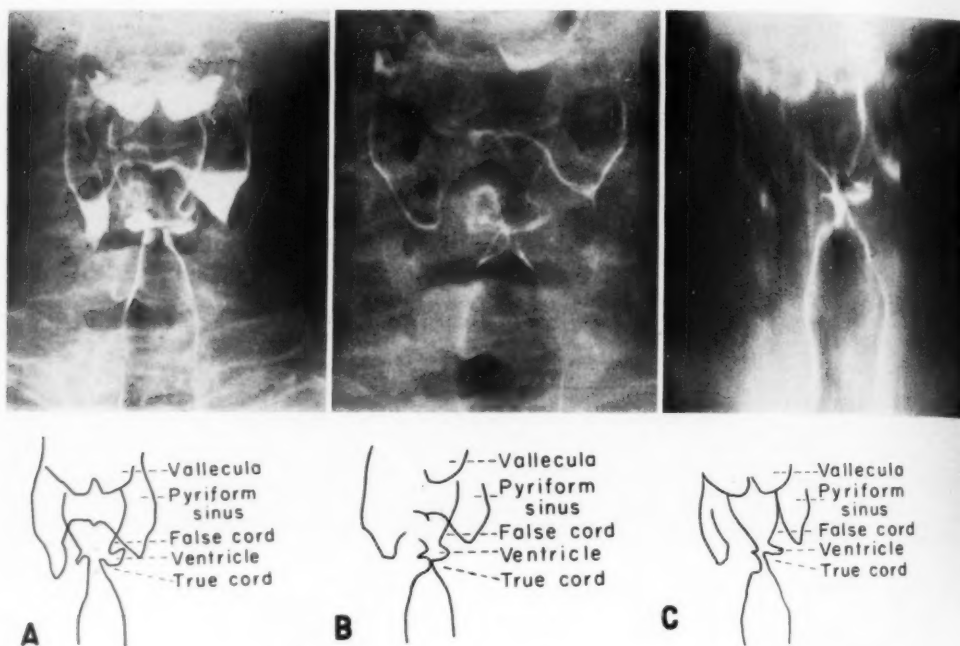


Fig. 5. Laryngeal Palsy

A. Inspiration. During quiet respiration there is asymmetry of the larynx and pyriform sinuses. Because of the anterior tilt of the arytenoid on the paralyzed side, the pyriform sinus on the affected side is broader and its base appears elevated above that of the normal pyriform sinus. The false cord on the paralyzed side appears larger and is slightly elevated. The free edge of the paralyzed true cord approaches the mid-line and is abnormally thin. The ventricle on the abnormal side is dilated. On the normal side, the subglottic region is convex because the cord retracts superiorly, whereas on the abnormal side this region is concave because of mid-line position of the cord.

B. Phonation. During phonation the only significant change in the paralyzed side is slight thinning of the free edge of the true cord. The normal true cord swings down so that its free edge approximates the paralyzed cord and its free surface is horizontal. The free edge of the paralyzed cord often overrides slightly the free edge of the normal cord. During phonation both ventricles fill with contrast medium, but that on the paralyzed side is considerably larger than the one on the normal side. There is characteristic fullness in the subglottic region of the flaccid cord as compared to the very sharp concavity in the subglottic region of the normal cord.

C. Laminagram obtained during phonation, demonstrating the findings shown equally well on spot-films.

respect to the spine and to the trachea. The closure of the cords produces a great alteration in the diameter of the lumen, and the ventricles fill with medium and are clearly demonstrated (Fig. 2).

When the patient performs a modified Valsalva maneuver, the oropharynx and hypopharynx are distended with air. The change in configuration of the pyriform sinuses is normal and is a sign of their pliability (Fig. 3).

The performance of the Valsalva maneuver produces complete closure of the larynx and almost complete obliteration of the hypopharynx. This is brought about by

approximation of the epiglottis and the arytenoids and closure of the true and false cords (Fig. 4).

LARYNGEAL PALSY

We have examined 10 patients with unilateral laryngeal palsy, all of whom displayed the characteristics so well described by Ardran *et al.* (1) and Calderon *et al.* (8). The method of contrast study, as we have employed it, demonstrates, without the use of tomograms or cineradiography, the anatomical and physiological characteristics of the paralyzed vocal cord (Fig. 5).

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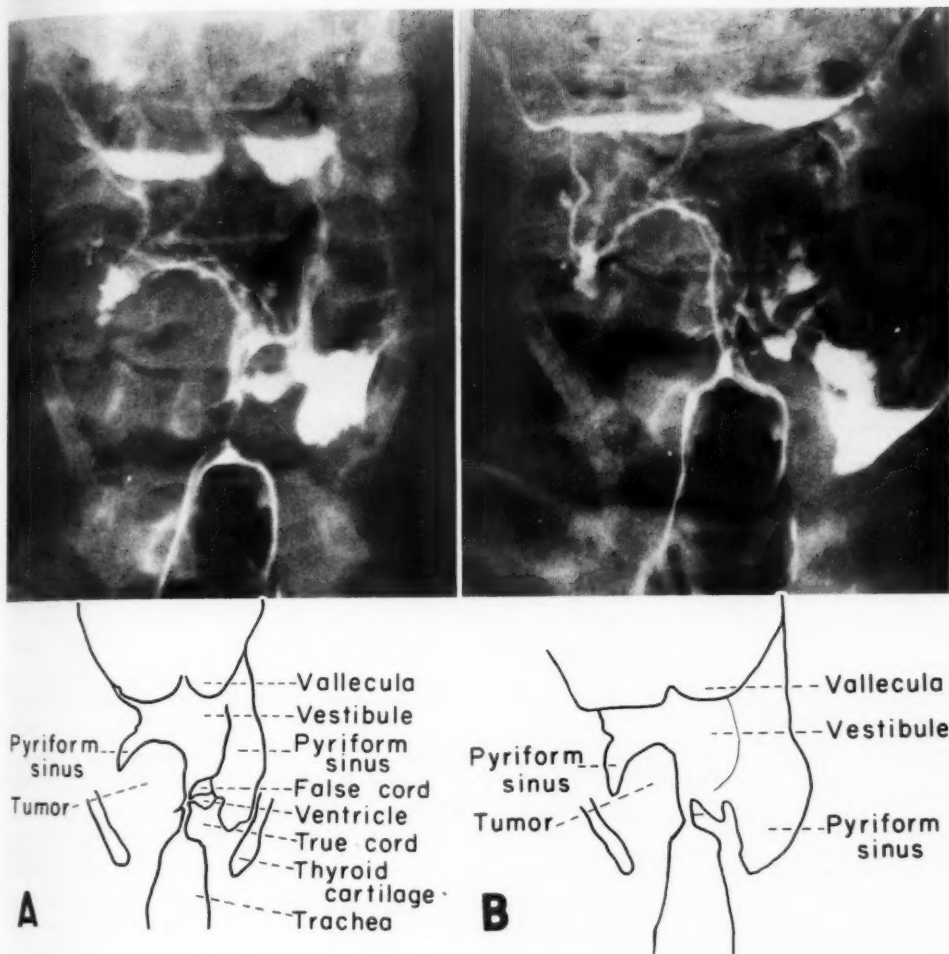


Fig. 6. Tumor of the Pyriform Sinus

Clinical History: J. S., a 50 year-old white male, had sustained a weight loss of 20 pounds in the six months prior to admission to the hospital. He had first noticed a mass in the right neck six weeks earlier, associated with pain in the throat. He complained also of a chronic cough, which had not increased particularly during the period of symptoms.

Physical examination disclosed a firm, non-tender mass, 3 cm. in diameter, in the anterior triangle of the neck on the right side. Indirect examination revealed an infiltrating mass in the hypopharynx with involvement of the right arytenoid, the right aryepiglottic fold, the laryngeal surface of the epiglottis, and complete distortion of the right pyriform sinus. Biopsy of the mass showed epidermoid carcinoma.

A. Inspiration. The vallecula on the right side is flattened and elevated as compared with the normal left vallecula. The right pyriform sinus is symmetrically narrowed, and the base is compressed and elevated. On the affected side the arytenoid eminence is enlarged, the true and false cords are thickened and displaced toward the mid-line, and the ventricle is almost completely obliterated. There is some asymmetry of the subglottic area on the right side as compared with the left, although it is thought that this probably represents extrinsic pressure rather than subglottic extension of the lesion.

B. Modified Valsalva maneuver. On performance of a modified Valsalva maneuver, the normal pyriform sinus distends markedly in contrast to the complete fixation and rigidity of the affected pyriform sinus.

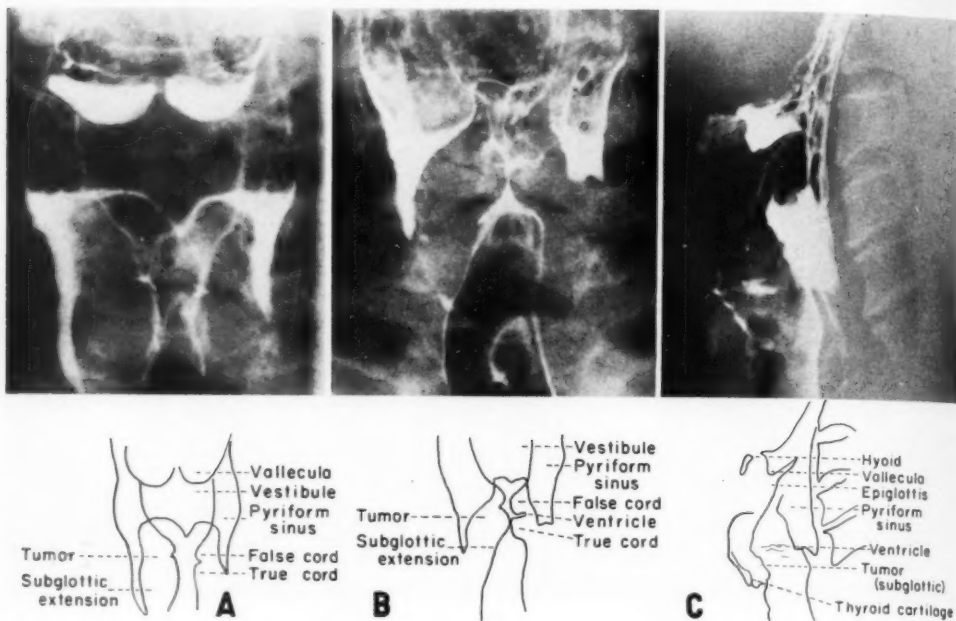


Fig. 7. Tumor of the Larynx

Clinical History: The patient gave a history of relatively recent onset of dyspnea on exertion and increase in a chronic slightly productive cough. While unable to give other significant symptomatology, he stated that he had had some pain when swallowing.

The base of the tongue, epiglottis, valleculae, and pyriform sinuses appeared normal. The right true cord was involved by a tumor and was completely fixed. The mass extended to the anterior commissure of the vocal cord and could be seen on both direct and indirect examination to extend into the subglottic region. Biopsy revealed epidermoid carcinoma.

A. Inspiration. The left pyriform sinus and left portion of the larynx appear normal. The right side exhibits many characteristic changes. The medial wall of the right pyriform sinus is displaced laterally and the sinus is elongated. The laryngeal vestibule is asymmetrical, and the false cord is elevated and enlarged. The laryngeal ventricle is small, and the true cord also appears enlarged. There is subglottic asymmetry and fullness, indicating subglottic extension on the right.

B. Phonation. The normal true cord and the abnormal right cord approach the mid-line, although there are irregularity and asymmetry at the site of apposition. Both the true and false cords on the right are much larger and thicker than those on the left.

C. Lateral view. There is an irregular posterior displacement of the anterior wall of the subglottic trachea as outlined by contrast medium. This mass, representing subglottic extension of the carcinoma, was not demonstrated on soft-tissue films with air contrast. The ventricle, although visualized, is poorly outlined in the lateral view.

TUMORS OF LARYNX AND HYPOPHARYNX

We have examined a variety of tumors involving the hypopharynx and have correlated the findings of direct and indirect laryngoscopy with the roentgen findings. The distortion produced is well demonstrated by our technic (Figs. 6 and 7).

DISCUSSION

Proper anesthesia and a satisfactory contrast medium have been most important factors in producing laryngograms of good quality. A well anesthetized patient is

better able to retain the contrast medium in the throat because of a reduction of the stimulus to cough and to swallow. Phonation, however, is not impaired. The smooth spread of the medium over the pharyngeal and laryngeal mucosa is of paramount importance. Dionosil Oily has afforded the smoothest coating and best contrast. Lipiodol was disappointing in that its distribution was frequently patchy, especially when delayed films were taken following bronchography. The rapid removal of Dionosil from the respiratory tree is also

a consideration. The technic described has almost uniformly produced films of diagnostic quality, even when the patient co-operated poorly.

The surface contrast technic in air-containing structures is ideal for the study of the anatomical and physiological changes in the pharynx and larynx. The clear delineation of anatomical detail with this method affords a means of detecting relatively minor deviations from normal. Not only are the gross structures well outlined, but the pliability and physiologic function of the individual parts can be determined, making this combined study superior to either component part.

In the case of a mass the surgeon is afforded an indication of the extent of the lesion by distortion and impairment of function of adjacent structures. The subglottic region, often difficult for the laryngologist to visualize, is easily demonstrated. The radiotherapist also has an additional technic with which to follow the effects of irradiation and also obtain an objective record of change. Not only can a decrease in the size of a mass be determined, but return of function can be readily assessed. This method of study, then, joins direct and indirect visualization, conventional radiography, and tomography in the diagnosis of disease of the larynx and pharynx.

SUMMARY

1. A technic of examination of the larynx and pharynx, utilizing topical anesthesia and contrast medium, has been described.
2. The anatomy and physiology of the normal larynx and pharynx are illustrated.
3. Cases demonstrating the use of the technic for study of abnormalities of function and anatomy are presented.

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SUMMARIO IN INTERLINGUA

Examine a Contrasto de Larynge e Pharynge

Pro le examine del pharynge e del larynge le autores ha usate un technica combinate a anesthesia e substantia de contrasto. Como substantia de contrasto illes trova Dionosil Oily le plus satisfacente.

Le methodo se revelava como ideal in le studio de alterationes anatomic e physiologic sub varie conditiones, per exemplo

phonation, proba de Valsalva, etc. Paralyse laryngee esseva demonstrate, e le distorsion producite per nove crescentias esseva clarmente visibile.

Le manovra del anesthetisation e del introduction del substantia de contrasto es in principio le mesme como in bronchographia.



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An Unusual Cystic Lesion of Bone, Limited to the Pelvis and Lower Extremities

Osteogenesis Imperfecta Cystica?¹

CHARLES A. BREAM, M.D., and WILLIAM H. SPRUNT, III, M.D.

THIS IS A SINGLE case report of an unusual bone lesion in a young Negro male. The diagnosis was complicated by major abnormalities in several other systems of the body, which may or may not be related. Roentgenograms taken at an interval of four years were available for study and two biopsies were done.

of the limbs. Both parents were reported to be in good health.

Physical Examination: The oral temperature was 97.8° F., pulse 100, respirations 44 per minute, blood pressure 120/80. The patient had the head of a man but the torso of a boy. He appeared acutely and chronically ill. He did not complain of pain but was quite dyspneic. The sclerae were normal in color. The fundi showed brownish streaks on the retinae, and there were arteriolar thinning and nar-



Fig. 1. Photograph of the patient made in August 1954.

A 26-year-old Negro (Fig. 1) was first seen at North Carolina Memorial Hospital on Aug. 26, 1954. He and his parents were unreliable in relating his history and had little sense of the passage of time. It was established that he was in good health until the age of three to six years. Sometime during that interval, while he was kneeling to pray, his legs suddenly gave way beneath him. Since then he had had "crooked legs" and had been bedridden. Four or five years after the initial mishap, sinuses exuding blood and pus appeared on both thighs.

In 1950, the patient was examined in another hospital, where he was found to have anemia and hypertension (230/150), as well as marked deformity of the lower extremities. Amputation was suggested but was refused. Films obtained at that time were made available for the present study.

Family History: The patient had two siblings who died of tuberculosis, and four younger brothers had died in infancy of unknown causes. To the knowledge of the family, none had anemia or deformity

rowing with increased tortuosity. The tongue and oral mucosa had a brownish tinge. The heart was enlarged, with regular rhythm and a grade II systolic murmur heard best at the apex. The liver was palpable just below the costal margin, but the spleen was not felt. The testes were quite small, the penis was of normal size, and axillary and pubic hair was sparse.

The upper extremities appeared normal, but the lower extremities were misshapen, enlarged, and grotesque. There were flexion contractures of both hips, knees, and ankles, with severe limitation of passive motion. The patient himself could move only his toes. Sinuses, draining pus and blood, were present on the lateral aspect of the right thigh and the anterior aspect of the left thigh. On the left a bony sequestrum could be palpated and seen but could not be extracted.

Laboratory Findings: Only the general laboratory data and those thought to be related to the bone disease will be presented. Aug. 26, 1954: hemato-

¹ From the Department of Radiology, University of North Carolina, School of Medicine, Chapel Hill, N. C. Accepted for publication in June 1956.

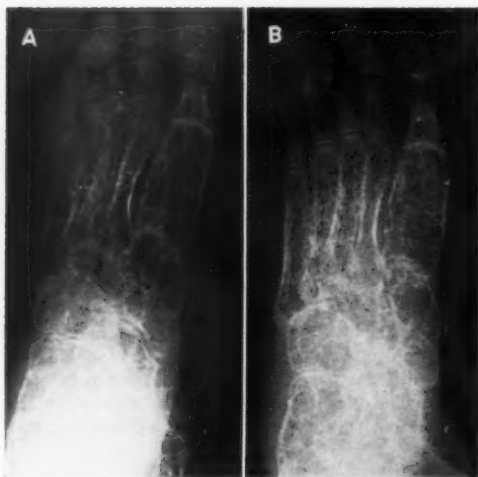


Fig. 2. Left foot in 1950 (A) and 1954 (B). During the interval there was no change. Notice the extensive cystic areas and the extreme cortical thinning. The right foot was identical in appearance.

crit 18; hemoglobin 5.7 gm.; red blood cells 2,120,000; white cells 18,900, with 84 per cent polymorphonuclears, 9 per cent lymphocytes, 5 per cent eosinophils, and 3 per cent monocytes; reticulocyte count 3 per cent; sickle-cell preparation positive; urine negative except for acetone; blood urea nitrogen 56 mg. per cent; serology negative. Aug. 27, 1954: serum calcium 9.3 mg. per cent; phosphorus 4.5 mg. per cent; alkaline phosphatase 13.3 units; total protein 7.7 gm. (albumin 1.81 and globulin 5.95 gm.). Sept. 27, 1954: serum calcium 10.3 mg. per cent; phosphorus 4.5 mg. per cent; alkaline phosphatase 14.6 units; total protein 8.6 gm. (albumin 3.1 and globulin 5.5 gm.).

Hospital Course: The bone disease remained stable, an observation which will be discussed later. Some of the other complex problems presented by this patient can best be covered by a short review of systems:

1. **Hematopoietic System.** The patient had sickle-cell anemia established by paper electrophoresis. The severe anemia on admission was considered to be on the basis of this disease, complicated by chronic osteomyelitis and azotemia.

2. **Urinary System.** There were a reduced glomerular filtration rate and a tubular disorder characterized by an inability (a) to conserve sodium and (b) to acidify the urine normally. This resulted in a tendency to the development of hyperchloremic acidosis and a decreased excretion of potassium.

3. **Endocrine System.** The patient had hypogonadism and slight gynecomastia but well developed genitalia. There was no evidence to suggest hypothyroidism or hyperparathyroidism. A normal water excretion test was unfavorable for a diagnosis of primary adrenal insufficiency.

4. **Cardiovascular System.** A history of hypertension extended over many years, complicated by hypertensive heart disease. While in the hospital, the patient went into frank cardiac failure and was successfully treated with digitalis and low sodium diet. Treatment of the cardiac condition was difficult because of the renal disease.



Fig. 3. Left tibia in 1950 (A) and 1954 (B). In the distal end of the tibia in 1954 there is a large cystic area not present on the previous study, thought to be related to biopsy of the medial malleolus in 1950. Otherwise the films are identical.

Roentgen Findings: All of the bones of the feet revealed cystic changes completely replacing the normal trabecular pattern. Marked cortical thinning was present (Fig. 2). The tibias and fibulas showed similar abnormalities, largely confined to the metaphyses. Sharply demarcated radiolucent areas in the diaphyses were suggestive of cartilage and lipid deposits. The only change which could be demonstrated in the disease process with the lapse of time was in the distal end of the left tibia, where a single large cystic area replaced some smaller cysts seen in 1950 (Fig. 3). This change is presumed to be the result of a previous biopsy.

The cystic changes in the femurs were accompanied by marked diaphyseal widening, within which could be seen the ghost-like shadows of normal appearing femoral shafts, remaining as sequestra (Figs. 4-6). The proximal end of the left femur could be palpated in the sinus on the left thigh. The diaphyseal cortex in both femurs was extremely thin and in some areas was absent. The angulation suggested

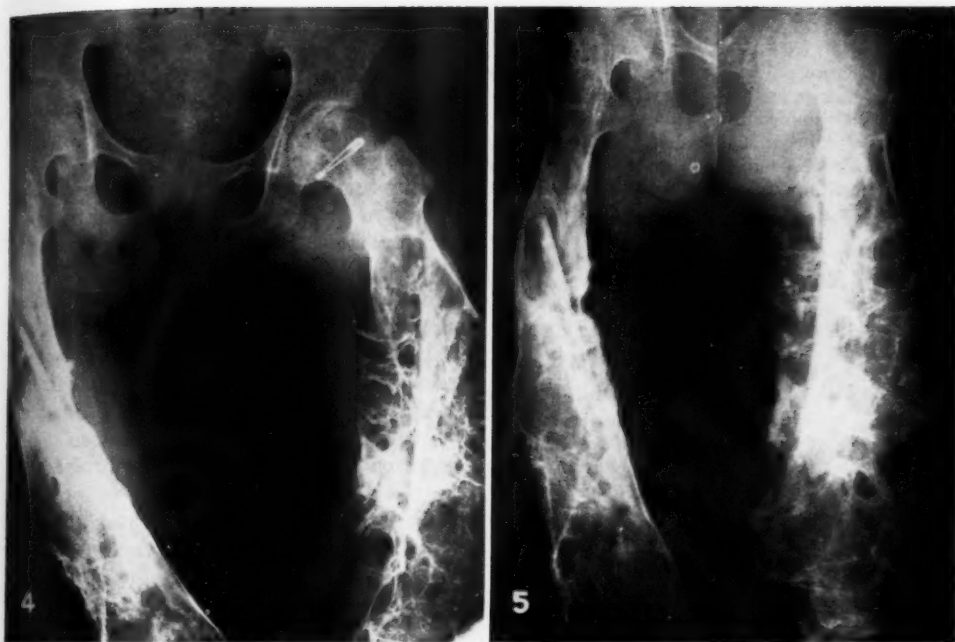


Fig. 4. Pelvis and femurs in 1950. Notice what appears to be a normal femoral shaft within the cystic bone. This is similar to illustrations showing hypertrophic callus formation in osteogenesis imperfecta, as mentioned in the text. The proximal end of the left femur could be palpated in a draining sinus on the lateral thigh. Changes are less marked in the pelvis.

Fig. 5. Femurs in 1954. Except for a difference in projection, the findings are identical with those in 1950 (Fig. 4).



Fig. 6. Pelvis in 1954. Comparison with the pelvis in 1950 (Fig. 4) is difficult from these reproductions, but the original films reveal no change. The density within the pelvis represents contrast material in the bladder.

previous fracture. Allowing for differences in projection, no change in the condition could be recognized in films obtained in 1950 and 1954.

The spine showed demineralization but no compression fractures, nor were any cyst-like areas found there. The skull, thorax, shoulder girdle, and upper extremities were normal, and lamina dura was present.

Pathology: Two biopsies were done at this institution. At the first, Sept. 9, 1954, several small fragments of bone were obtained from the anterior surface of the right mid-tibia. Dr. Robert D. Langdell made the following report of the microscopic findings: "The specimen consists of fragments of dense cortical bone. There is no evidence of osteoblastic activity, but dark staining cement lines present suggest secondary bone formation. In scattered areas empty lacunae are present suggesting degeneration. No actual necrosis or inflammatory reaction is present. The histology is non-specific but is similar to that seen in areas adjacent to osteomyelitis. *Impression:* Bone fragments with non-specific degenerative change."

The left lateral malleolus was the site of the second biopsy, Oct. 6, 1954, and Dr. Langdell received a fragment of bone 2.3×0.7 cm. The cortical bone measured 0.5 mm. at its thickest point. The report of the microscopic examination was as follows: "The cortical bone is of variable thickness. In some areas it appears to be absent, and periosteum is seen immediately adjacent to marrow. The individual bone trabeculae are fragmented, thin, and fewer in number than usually seen. The marrow consists of mature fat cells and shows no hematopoietic activity. No abnormal cells are seen, although there is a slight increase in dense fibrous tissue throughout the marrow. The histology is not specific but some aspects suggest osteogenesis imperfecta."

The slides of the biopsy made four years previously could not be obtained.

DISCUSSION

In attempting to diagnose the skeletal lesion, the first problem was to decide whether all of the findings could be related. In our experience and in the experience of the many physicians with whom we discussed the case, this seemed very unlikely. The possibility of relating the skeletal lesion to one of the other systems was then entertained. Two chief considerations were (a) to ascribe the changes to sickle-cell anemia or (b) to relate them to hyperparathyroidism.

Though the abnormalities of the bones of the feet resembled those which occur in

Cooley's anemia, so far as we are aware no changes of this type have been described in sickle-cell anemia. In either event the upper extremities should also have been involved. Osteitis fibrosa cystica was suggested at the time of the original roentgen examination of the femurs, before films of the remainder of the skeleton were obtained. The blood chemistry determinations, the presence of lamina dura, the localization of the disease to the lower extremities, and the biopsy all exclude this condition.

Uncomplicated osteitis fibrosa polyostotica was also ruled out by the biopsy material (7). Reported cases of lymphangiectasis have shown a somewhat similar roentgen appearance, due to the obstruction of the lymphatics, giving rise to multiple cyst-like lesions involving wide areas (4). This diagnosis was not confirmed by biopsy. Although draining sinuses were present at the sites of the femoral fractures, osteomyelitis, even though atypical, would not cause the changes present in the legs and feet. Malignant neoplasm would be more progressive and at sites of cortical rupture would have extended into the soft tissues, but biopsy showed no such findings. Hemangioendothelioma of bone results in a similar roentgen appearance, but again there was no evidence of this condition at biopsy and the lack of progression is against it (8).

The occurrence of pathologic fractures at an early age suggested a congenital lesion. Fairbank illustrates a case, which he classifies as osteogenesis imperfecta cystica, resembling this one (6). He states that this form of the disease is extremely rare, only 2 cases having been reported and one postmortem skeleton having exhibited the characteristic findings. In this condition there may be an absence of familial history and blue sclerae. Bony abnormalities are most marked in the lower extremities, but the disease is generalized and progressive. Since the cystic lesions in our patient were confined to the lower extremities and there had been no significant progression in four years, this diagnosis

seemed unlikely, despite the close radiologic similarity. It was felt, however, that in view of the pathologic report of osteogenesis imperfecta and the absence of foam cells in the specimen, this possibility could not be excluded.

Assuming that the primary condition was osteogenesis imperfecta, an interesting secondary consideration for the femoral abnormality was the possibility of hyperplastic callus formation which may have occurred following the fractures. Fairbank and Baker (5), Baker (1), and Brailsford (2) reported cases of this type which radiologically were very similar to that recorded here. Since no evidence of fracture could be recognized in the tibias, tarsals, or phalanges in our patient, this would not account for the disease process in these bones.

We were struck by the marked similarity in the radiologic appearance of the lesions in our patient and in an African Negro boy described by Burkitt and Fairbank (3). They diagnosed their case as an "unusual lipid reticulosis of bone." Typical foam cells of the Gaucher type were found on biopsy. The lesion was confined to the left lower extremity except for a cyst-like area in the right humerus. The fact that no foam cells were observed in our case might be explained if the biopsy were from a "burned-out" area. The sites of biopsy in the 2 cases, however, had the same radiographic appearance.

We have discussed this case with a number of radiologists, orthopedists, and pathologists, showing them the films reproduced in this paper, as well as the tissue sections, and we have attempted a moderately thorough search of the literature without arriving at a satisfactory diagnosis. Our report therefore must be of an "undiagnosed abnormality of bone."

ACKNOWLEDGMENT: We are grateful to the several physicians who gave their opinions, advice and suggestions on this case, especially to Dr. Henry L. Jaffe.

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SUMMARIO IN INTERLINGUA

Un Inusual Lesion Cystic de Osso, Restringite al Pelve e al Extremitates Inferior: Osteogenese Imperfecte Cystic (?)

Un masculo negre de 26 annos de etate habeva pronunciate deformitates del extremitates inferior, presente deposit de prime infantia, con contracturas de flexor in ambe coxas, genus, e cavilias, sever limitation de motion passive, e sinuses con drainage de pus e sanguine in ambe femores. Omne le ossos del pedes revelava alterationes cystic e grados extreme de tenuification cortical, e simile alterationes

esseva presente in le tibias e le fibulas. Le alterationes cystic in le femores esseva accompaniate per allargamento e tenuification diaphysal e in certe areas per le absentia del cortice diaphysal. Le alterationes esseva restringite al extremitates inferior e al ossos pelvic e revelava nulle progresso in le curso de quatro annos de observation.

Ben que le patiente habeva anemia a

cellulas falciforme, le constatationes non esse explicabile super le base de ille condition. Altere possibilitates considerate sed eliminate como incompatible con observationes biptic, laboratorial, e clinic esseva osteitis fibrose cystic, osteitis fibrose polyostotic, lymphangiectasis, osteomyelitis, e lesiones neoplastic.

Le plus proxime correspondentia a iste caso se trova in un caso reportate per Fairbank como osteogenese imperfecte cystic. Iste possibilitate non pote esser rejicite, ben que le absentia del generalisation del processo in le skeleto e le character non-progressive del condition rende un tal supposition pauc probabile.



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Hyaline Membrane Disease: Preclinical Roentgen Diagnosis

A Planned Study¹

S. B. FEINBERG, M.D., and M. E. GOLDBERG, M.D.

NEONATAL respiratory disease remains one of the major causes of death, especially in the premature infant. In this group an estimated 10,000 to 20,000 deaths occur each year (4, 25, 29, 35). What is now called hyaline membrane disease of the newborn was first described in 1903 in Germany (16) and in 1923 in the United States (17). In spite of this, progress in establishing unequivocal pathogenesis, diagnosis, and treatment has been slow. With this in mind, we undertook a study to determine whether the diagnosis could be made before the development of clinical symptoms, thereby facilitating prompt treatment.

CLINICAL AND PATHOLOGIC FINDINGS

Infants with hyaline membrane disease are usually premature, delivered by section, or born of a diabetic mother. Their stage of development must be sufficiently advanced (1,000 or more grams weight; seven months of gestation) to permit normal pulmonary gas exchange (31). The condition occurs only in infants who breathe after birth, never in the stillborn (3, 4, 25, 35). In a matter of minutes to hours breathing becomes labored, as if against obstruction; sternal and costal retraction with cyanosis may develop, and death may ensue (3, 9, 15, 18, 21, 27, 28, 32, 35, 38, 40). Recent reports have charted the progress of the disease by recording respiratory rates (14, 28). By the time 60 per minute is reached, serious clinical disease may be expected. Since not all the infants die, the diagnosis cannot always be confirmed (31, 34, 35, 38).

Grossly the lungs appear dark red to purple and markedly engorged. They contain few or no gross air-filled spaces.

Microscopically the capillaries are engorged, and the alveoli and alveolar ducts may be collapsed. The few remaining air spaces are lined with a hyaline-like material (1, 5, 8, 9, 18, 24, 39). In certain stages of the disease the alveolar ducts may be dilated, which accounts for the degree of aeration seen radiographically. There has been criticism that too much emphasis has been placed on the membrane *per se* and not enough on the atelectasis (21).

Briefly, the concept of aspiration of amniotic fluid (4, 8, 9, 21, 25) has been supplanted by many studies which favor an endogenous origin of the disease (2, 12, 13, 20, 26, 35, 36). One study showed the hyaline staining material beneath the basement membrane (12). This report also implicated both endogenous and less significant exogenous factors. Chemically, the membrane is a polysaccharide aldehyde (20, 36) which has been all inclusively termed a protein-carbohydrate (12).

No specific therapy has been developed, but the treatment of choice has resolved to a simple formula of high humidity (29, 32, 35, 38, 41) without a water mist supplement (33). There has been a recent suggestion that the treatment be that of left heart failure (19). High oxygen concentrations are not advocated. A new respirator for the treatment of atelectasis, which is probably the significant clinical problem, has been described (7), but its evaluation awaits further experience.

ROENTGEN FINDINGS

The roentgen findings in advanced cases of hyaline membrane disease have been described (6, 7, 11, 22, 23, 30, 34). These vary from a granular pattern distributed throughout both lung fields to a completely

¹ From the Department of Radiology, University of Minnesota Hospitals, in association with Ancker Hospital, St. Paul, and Mt. Sinai Hospital, Minneapolis, Minn. Accepted for publication in July 1956.

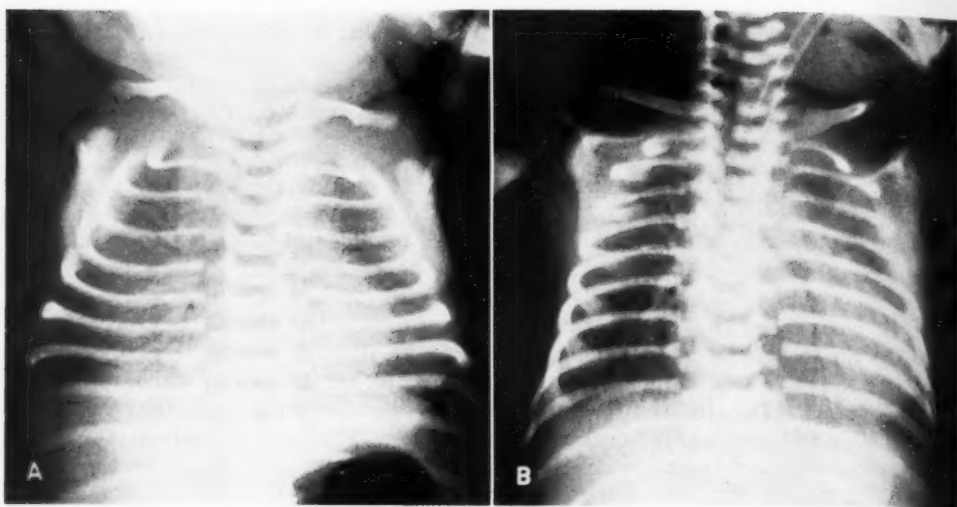


Fig. 1. Premature male infant (thirty-three weeks).
 A. One-hour film, showing preclinical granularity. At two hours respirations became labored and sternal retraction and cyanosis appeared. The child was placed on a high-humidity, oxygen, and antibiotic regimen.
 B. Forty-eight-hour film, showing granular to homogeneous atelectasis, with air-filled bronchi. Death at fifty hours. *Pathologic diagnosis:* Hyaline membrane disease.

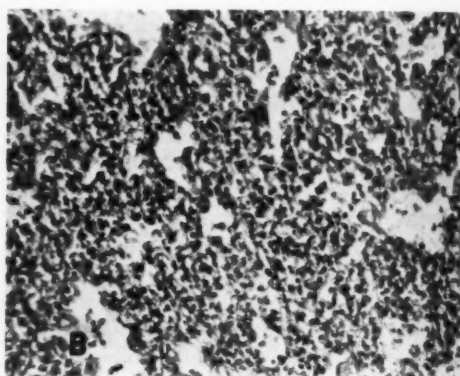
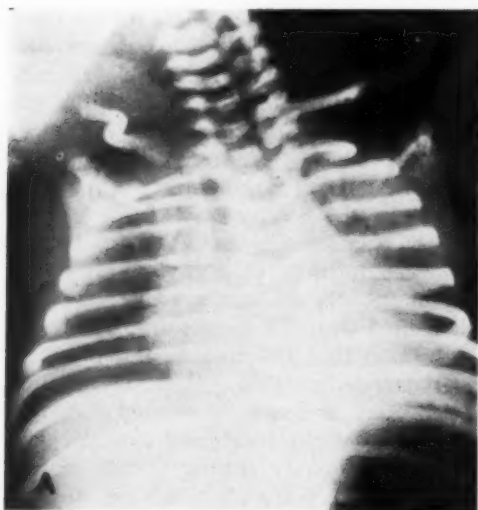


Fig. 2. Premature female infant (twenty-eight weeks; weight 3 lb. 4 oz.). Color and respirations normal.

A. First film, showing diffuse, finely granular pattern in both lung fields. No clinical signs at this time. At nine hours, substernal and suprasternal retraction developed, with cyanosis. In spite of treatment with high humidity and oxygen, death ensued at thirty-six hours.

B. Photomicrograph ($\times 110$) showing hyaline membrane lining alveolar ducts, with collapsed alveoli. No aerated alveoli are seen.

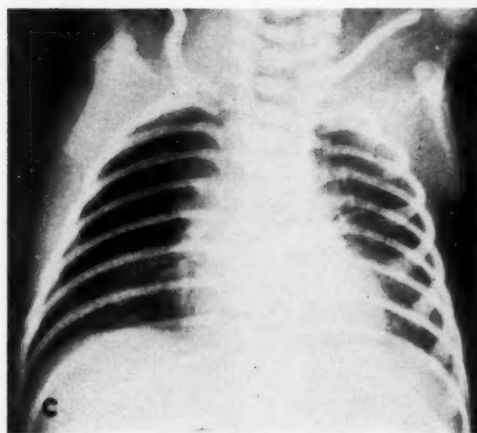
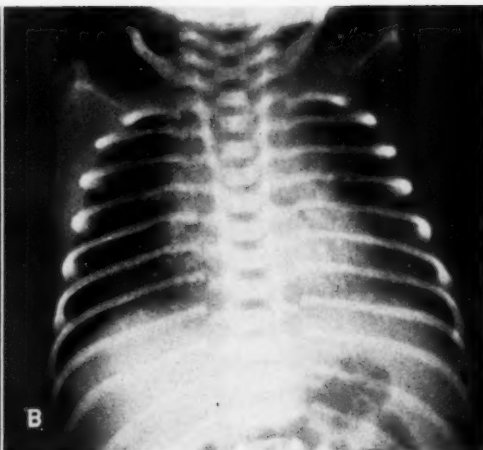
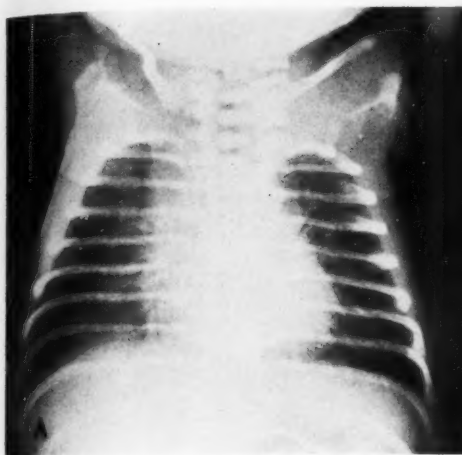
homogeneous density which blends with the mediastinum. The picture is due to various degrees of atelectasis.

As to the early roentgen diagnosis, no agreement exists. One point of view is that the chest at first appears normal (23). A recent report simply states that early chest films are abnormal (30). Unfortunately it does not say how early in the

course of the disease the abnormal films were taken or how advanced the respiratory distress was; most of the cases in the series were reviewed proved cases, only a portion being from a planned study. An

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earlier article (6), reviewing 28 cases, reports positive findings three hours after birth, but symptoms had already developed at that time.

PRESENT STUDY

Eighteen months ago we initiated our study with the purpose of evaluating early roentgen lung changes, prior to the manifestation of respiratory distress (11). At the University of Minnesota Hospitals, and later at both Ancker Hospital of Saint Paul and Mt. Sinai Hospital of Minneapolis, we instituted the following routine for (a) all premature newborn infants, (b) those delivered by section, and (c) those born of diabetic mothers. The first film was taken as soon after delivery as possible, or at least within the first hour of life, for our prime concern was to obtain radiographs prior to the onset of symptoms rather than review those taken after the disease was suspected or far advanced. The follow-up films were taken at two-, four-, eight-, and twenty-four-hour intervals. If necessary, further examinations were done.

In all, 89 infants were followed. Seven were delivered by section, and in 1 of this group the findings were positive. Eight of the series had histologically proved hyaline membrane disease (Figs. 1, 2, and 3). Two had apparent disease and survived (Figs. 4 and 5). One infant not in-

Fig. 3. Premature female infant (six months, weight 3 lb. 4 oz.), in whom normal respiration was not established until ten minutes after birth.

A. First film, showing diffuse granularity suggesting hyaline membrane disease.

B. Five-hour film showing progressive degree of granularity in spite of an apparently normal clinical course. Classical signs of hyaline membrane disease developed at nine hours.

C. Twenty-one-hour film.

Death at twenty-nine hours. *Pathologic diagnosis:* Hyaline membrane disease.

cluded among the first 8 had roentgen and clinical findings compatible with a diagnosis of aspiration pneumonia, and this was the gross pathologic impression as well, but some isolated hyaline-staining material was found in one area (Fig. 6). The cases included in this study were those radiographed before the onset of symptoms.

Seventy-four of the infants were normal.

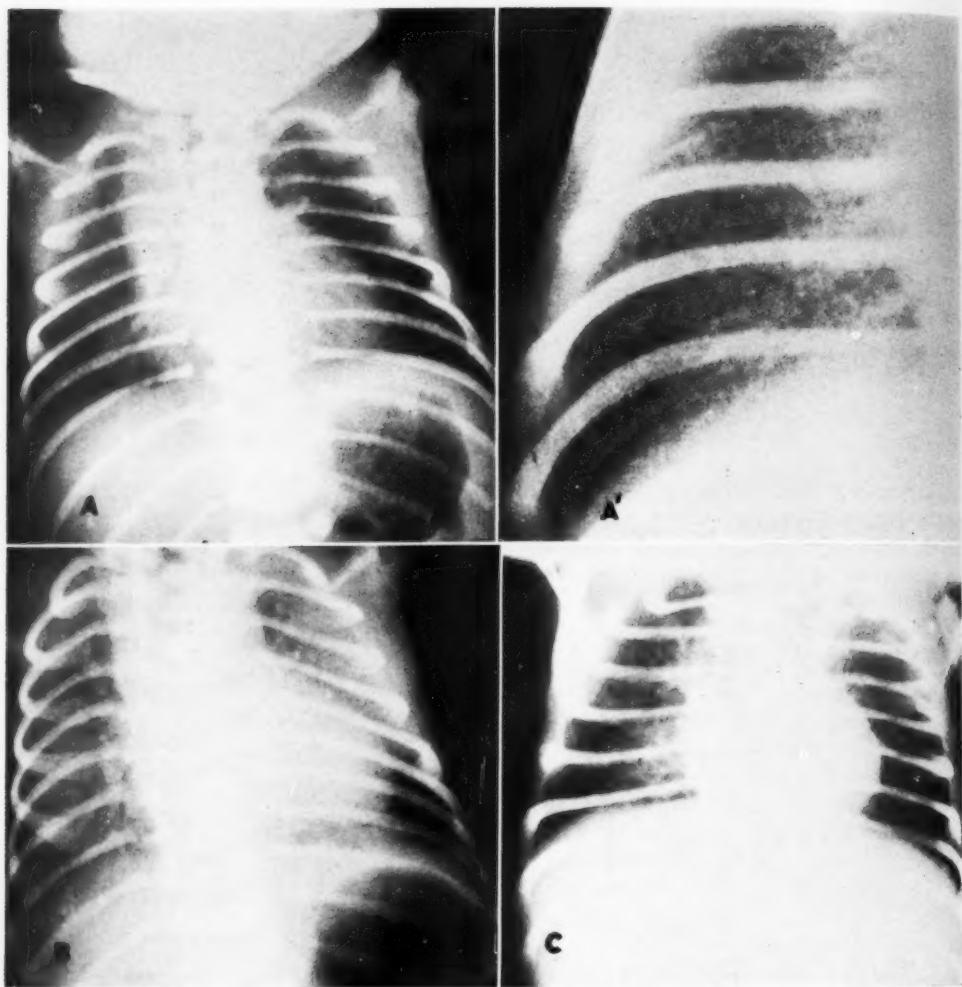


Fig. 4. Premature male infant (seven months; weight 3 lb. 10 oz.).
 A. Fifteen-minute film, showing fine bilateral granularity. Grunting respiration developed almost simultaneously with the taking of this film, followed gradually by rib cage retraction and cyanosis. Peripheral edema also occurred.
 A'. Enlargement of right lower lung field showing diffuse fine granularity.
 B. Eight-hour film, showing progression to obvious granularity. Truncated appearance of chest.
 C. Seventy-two-hour film, after clinical improvement. The granularities have begun to clear. Treatment was limited to high humidity, oxygen, and penicillin. Full recovery in six weeks.

Our impressions of the newborn chest seem more in keeping with earlier descriptions (10, 37) than with those of a more recent report (30). We too felt that the truncated thoracic cage is the rule rather than the exception. Likewise we considered some degree of prominence of the bronchovascular markings and parenchymal

nodularity incident to incomplete aeration to be of normal occurrence in the premature newborn.

As was anticipated, the one- to two-hour interval radiographs were of the greatest diagnostic value. In 7 of the 8 proved cases of hyaline membrane disease unequivocal abnormality was demonstrable

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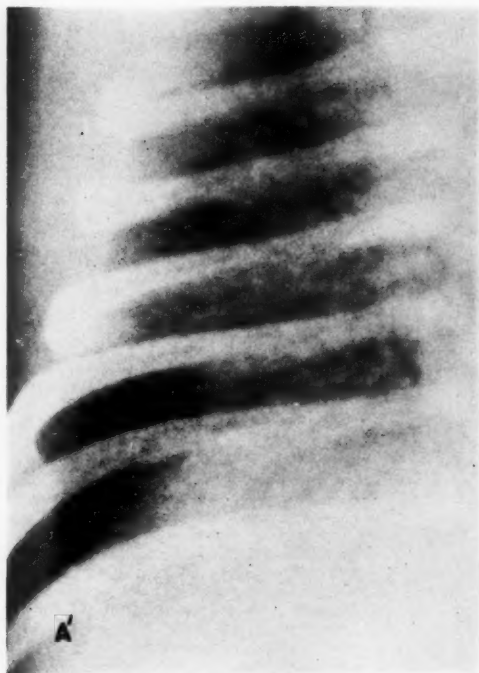
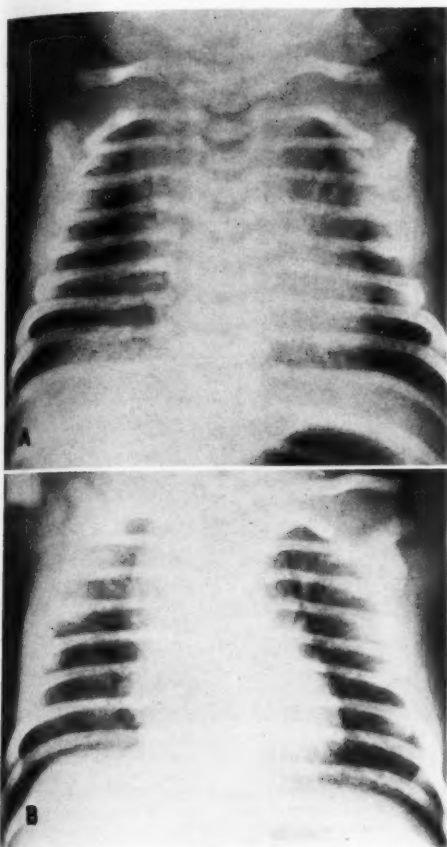


Fig. 5. Infant born by section at forty weeks (weight 5 lb. 10 oz.). Normal at birth.

A. Forty-five-minute film, showing bilateral granularity suggesting hyaline membrane disease.

A'. Enlargement of right lower lung field showing the diffuse granularity.

At six hours the respiratory rate began to increase, until at twenty-four hours it reached 60 per minute. No cyanosis developed.

B. Film showing improvement after respiratory rate began to slow at forty-eight hours.

on the initial film. The other case showed signs suggestive but not diagnostic of the disease. In 2 infants early roentgen and later clinical signs of the syndrome eventually cleared. The roentgenographs in these instances showed the same findings as did those in the fatal cases.

Careful examination of the early films revealed a finely granular pattern symmetrically distributed throughout both lung fields (Figs. 1A, 2, 3A, 4A, 5A).

The granularity was not as prominent as in the fully developed cases. The three-hour and later interval films show the classical picture (6). In addition, the linear hilar and perihilar bronchovascular strands, which are ordinarily exaggerated in the newborn premature infant, were abnormally prominent. Follow-up examinations showed gradual progression to the obvious granularity described in the literature (Figs. 1B, 3B, 4B, 5B). Eventual frank localized or generalized atelectasis developed. As mentioned, the granular densities apparently represent alveolar atelectasis, whereas the relative aeration is due to air-filled alveolar ducts.

In 3 cases the lag between the roentgen findings and clinical manifestations of the disease was particularly marked. Though there was a high index of suspicion for hyaline membrane disease on the first radiographs, vigilant pediatric observation failed to discover clinical signs until nine hours later in one and six hours later in the other, when the respiratory rate began to

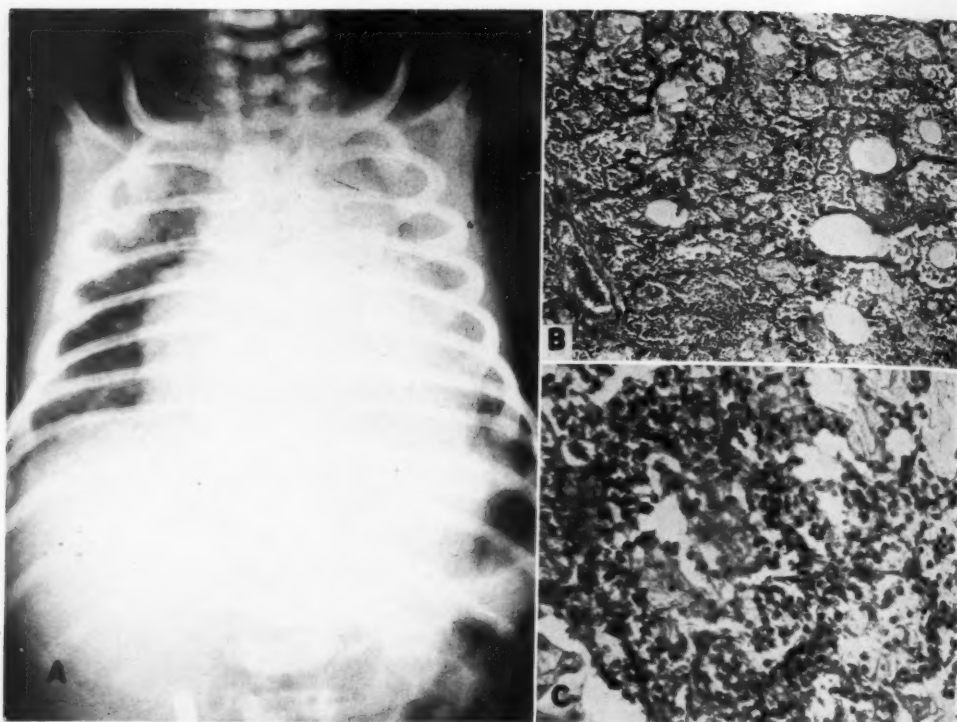


Fig. 6. Forty-three-week male who breathed normally at birth (weight 8 lb. 8 oz.). Flaccidity of extremities was noted. At fifteen minutes, bradycardia and dyspnea developed.

A. Heart appears large. Bilateral asymmetrical nodularity is suggestive of aspiration pneumonia. Death at twenty-four hours. *Gross pathologic diagnosis:* Bilateral pneumonia; heart normal.

B. Low-power (×50) view showing amniotic debris filling alveoli and alveolar ducts.

C. High-power photomicrograph (×130), showing isolated hyaline membrane lining an alveolar duct.

increase, reaching 60 per minute over the next twenty-four hours. In the latter case the respiratory rate and physical and roentgen findings began to clear in forty-eight hours. In 7 of the 10 cases, symptoms developed from fifteen minutes to three hours after birth, at which time labored respirations, sternal and costal retraction, and cyanosis were noted.

The subtle but definite early granularity which progressed to diffuse lung changes after the onset of symptoms was not encountered in the normal or non-hyaline membrane problem cases.

CONCLUSIONS

The early diagnosis of hyaline membrane disease may be fostered by the institution

of a simple chest radiograph routine. This should include at least one examination within the first hour as well as a second hour follow-up film in all premature infants, those born of diabetic mothers, and those delivered by section.

There is no question that the descriptions of earlier granularity and later eventual frank generalized atelectasis, especially in fatal cases, are reliable diagnostic criteria for advanced hyaline membrane disease. We feel that, if one were alerted to the finely granular and increased bronchovascular pattern before the development of physical signs, one might anticipate the diagnosis earlier than it has heretofore been suspected.

It is hoped that the correlation of early roentgen findings with a new approach to

therapy for overcoming and preventing further atelectasis may aid in reducing infant mortality due to this condition.

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(Pro le sumario in interlingua, vider le pagina sequente)

SUMMARIO IN INTERLINGUA

Roentgenodiagnose Preclinic de Morbo del Membrana Hyalin: Un Studio Planate

Proque morbo del membrana hyalin ha le tendentia de occurrer in infantes prematur, in infantes nascite per section, e in infantes de matres diabetic, un studio preplanate esseva interpretate in un serie de 89 infantes del categorias mentionate con le objectivo de determinar si un diagnose roentgenologic del condition es possibile ante le disveloppamento de signos clinic. Le prime roentgenogramma esseva obtenite intra le prime hora post parto, sequite per alteres a intervallos de duo, quatro, octo, e vinti-quatro horas.

Occurreva in iste serie dece casos de morbo del membrana hyalin. Octo esseva confirmate al necropsia. In duo le infantes superviveva, e le diagnoses esseva basate super constataciones clinic e roentgenologic. In septe del casos de demonstration necroptic, anormalitates inequivoc se re-

velava in le prime roentgenogramma in le forma de un conformation finissimamente granular que esseva distribuite a transverso ambe campos pulmonic. In le octave caso le constationes initial esseva de fortia suggestive sed non conclusive. Con le disveloppamento del symptommas in le curso de alicun horas, il occurreva un progression del granularitate e le disveloppamento de atelectasis franc.

Es exprimate le opinion que si on poteva prestar attention al presentia del configuration finmente granular e al augmento del configuration bronchovascular que precede in le pulmones le disveloppamento de signos physic de morbo del membrana hyalin, le diagnose poterea esser establite plus promptemente, le tractamento poterea instituer se plus tosto, e le resultato esserea un reduction del mortalitate.



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A Note on the Roentgen Features of Bronchial Adenoma of the Peripheral Type¹

IRWIN BLUTH, M.D.

BRONCHIAL adenoma is a neoplasm which is generally considered to be benign, but may on occasion present malignant features. It represents from 6 to 10 per cent of all primary lung neoplasms. In contrast to carcinoma of the lung, adenoma is of equal incidence in both sexes. In a series of 86 cases reported by Moersch and McDonald (1), 45 occurred in men and 41 in women. Almost 90 per cent of the patients were less than fifty years of age. The clinical picture is dependent upon the location of the adenoma. Cough is a common symptom. Because of the vascularity of the neoplasm, hemoptysis is frequent. If obstruction to a pulmonary segment occurs, the symptoms are those of associated recurrent pneumonitis and bronchiectasis.

PATHOLOGY

Topographically, bronchial adenomas may be either central or peripheral. They are thought to arise in the mucous glands (2), and this origin helps to explain their relatively frequent occurrence in the main order bronchi, in which such glands are abundant. Occasionally an adenoma may be seen more peripherally, in the lesser bronchi, as far out as the smallest branches.

Of the two histologic types described, the carcinoid and the cylindroid, the former is the more common, accounting for up to 85 per cent of cases. The growth is occasionally invasive or metastasizing, in which event tumor cells may be found in bronchial or tracheobronchial lymph nodes or in isolated lymphatics in the mediastinum. Spread to the liver, kidneys, and vertebrae has been reported. Death, however, is rarely attributable to metastases.

Because of the high incidence of origin from the primary bronchi, bronchoscopy usually is of great value in bronchial

adenoma. This is not true, however, when the tumor is peripherally situated. Moersch and McDonald (1), among 84 patients with bronchial adenomas examined bronchoscopically, were able to visualize 78 of the neoplasms. This is a much higher incidence of visualization than is obtained in bronchogenic carcinoma. Grossly, part of the tumor is usually seen to project into the lumen of the bronchus, but a considerable portion may extend through the wall into the lung tissue.

ROENTGENOLOGY

The roentgen features of bronchial adenoma depend upon the anatomical location. The relatively uncommon peripheral tumor usually appears on the roentgenogram as a circumscribed density with a suggestion of lobulated borders. Good and Harrington (3) report 17 of these lesions, 1.5 to 8.0 cm in diameter. They are to be differentiated from a peripherally located primary carcinoma of the lung, a solitary metastasis, and other benign neoplasms, such as hamartoma. The bronchial adenomas which are situated in the main order bronchi frequently cannot be visualized on the conventional film. However, tomography, with demonstration of the air-outlined bronchi, or bronchography, with opacification of the bronchial tree, will most often show a filling defect produced by the projection of the neoplasm into the lumen of the bronchus. On the other hand, the chest film may show features incident to the intrabronchial location of the lesion.

From August 1949 to August 1950, 3 cases of bronchial adenoma of peripheral type were encountered on the thoracic surgical service of the Beth-El Hospital (Brooklyn, N. Y.). In no instance was the diagnosis established before the re-

¹ From the Beth-El Hospital, Brooklyn, New York. Accepted for publication in June 1950.

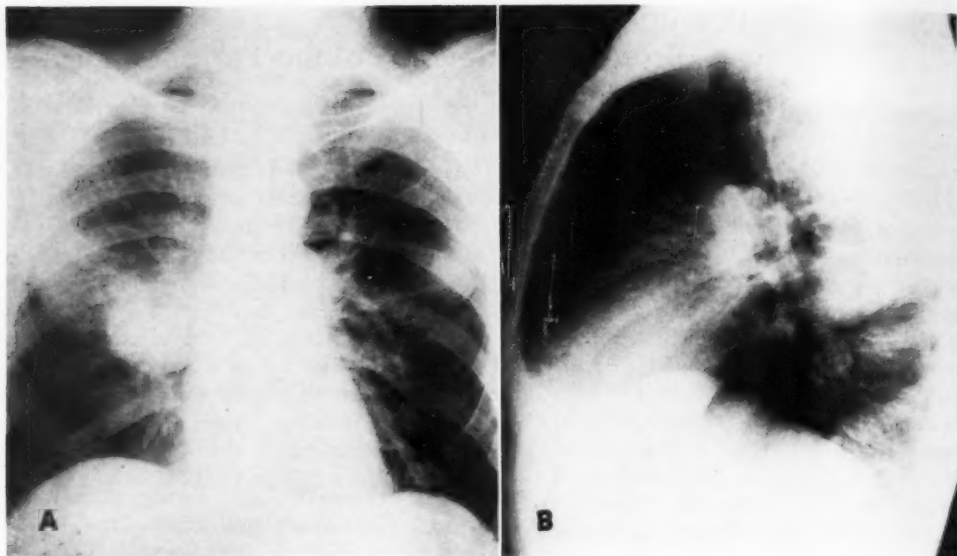


Fig. 1. Case I. A. Postero-anterior view of the chest, revealing a large circumscribed density overlying the shadow of the right hilus.

B. Lateral view, in which the density is seen to be situated posteriorly, in the region of the apical segment of the lower lobe.

sected segment of lung was studied by the pathologist (Dr. David Spain). As was to be expected, in view of the peripheral location, there were no clinical symptoms referable to the lesions. In each case, the tumor was an incidental finding on a chest film. Two of the patients were males, aged forty-one and fifty-one. The female was thirty-seven.

CASE REPORTS

CASE I: J. R., a 41-year-old white male, was first admitted on Aug. 22, 1950, with a history of a mass in the right lung for a period of six years, and sharp and stabbing right chest pain for two years, which was aggravated by deep inspiration. A morning cough was productive of half a teaspoonful of whitish sputum. Physical examination was non-contributory.

X-ray films, Aug. 29, revealed a well defined ovoid density, 5 cm. in diameter, in the apical portion of the right lower lobe, just to the right of the cardiac shadow (Fig. 1). There were no positive laboratory findings.

At operation a mass measuring 5 cm. in maximum diameter was found near the main bronchus but not in apparent communication with it.

On pathologic examination, the tumor was found to be composed of homogeneous, yellow-gray mate-

rial and to contain several areas of hemorrhage. It was well encapsulated and could be shelled out.

Diagnosis: Bronchial adenoma.

CASE II: L. T., a 51-year-old white male, was admitted on July 7, 1950, complaining of heaviness in the left chest. His company physician had found a "spot" in the left lung on fluoroscopy. The patient experienced an occasional morning cough. Physical examination was non-contributory.

Roentgenograms revealed a circumscribed opacity in the left mid-lung field, which extended anteriorly (Fig. 2). There were no positive laboratory findings.

At operation an ovoid encapsulated tumor, $5 \times 4 \times 2$ cm., was found.

Pathologic examination showed small fragments of green-black lung parenchyma attached to the surface of the capsule. Also observed was a smaller fragment of tissue similar to that of the large mass; the latter was composed of a uniform translucent, soft, light tan tissue, with lobulation at the surface.

Diagnosis: Bronchial adenoma.

The patient remained in satisfactory condition until the third postoperative day, when there was a sudden episode of twitching, with rolling of the eyeballs, dyspnea, and cyanosis. Death occurred within an hour.

CASE III: E. G., a 37-year-old white female, was admitted on Aug. 30, 1949, because of a mass in the right lung discovered on a routine chest film.

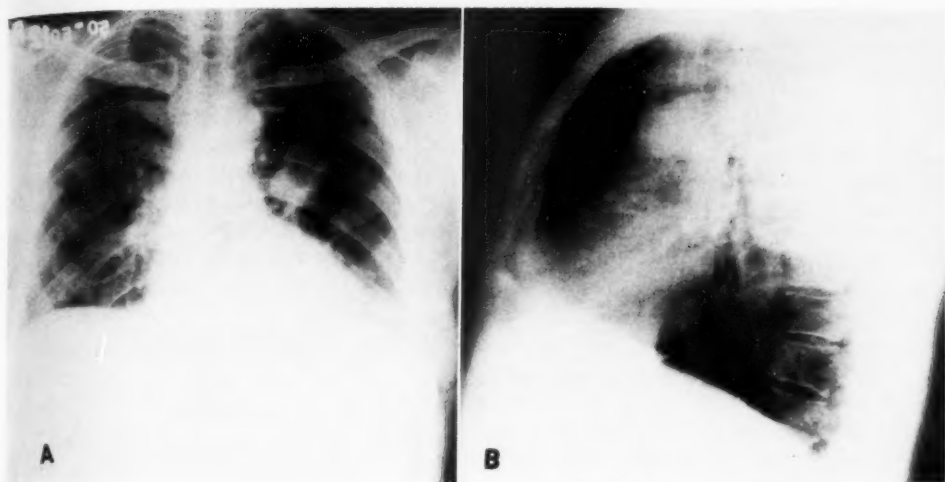


Fig. 2. Case II. A. The circumscribed tumor, with evidence of some lobulation adjacent to the left hilum. B. Lateral view, showing the mass extending anteriorly in the left upper lobe.

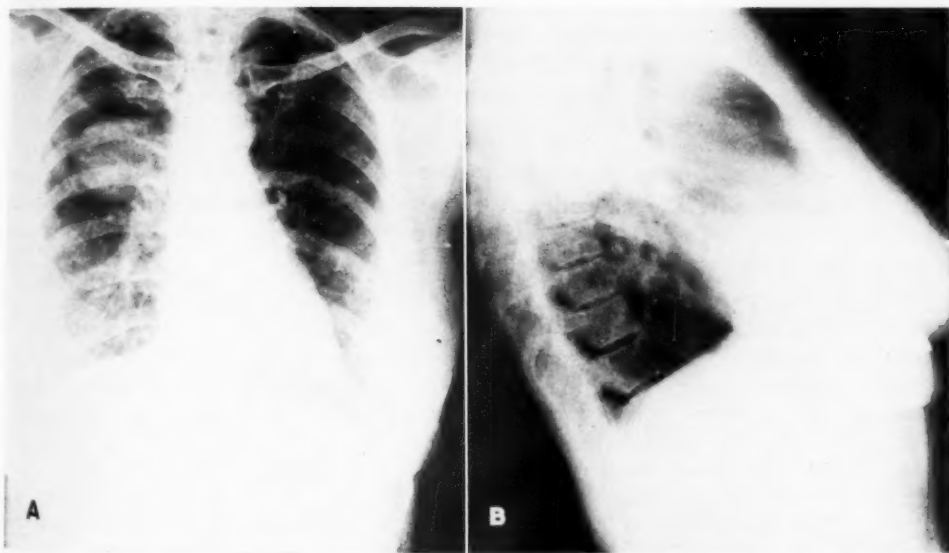


Fig. 3. Case III. A. A large, sharply demarcated circumscribed lesion in the right middle lung field. B. Lateral view, in which the tumor is seen to be situated posteriorly in the right upper lobe.

She gave a history of frequent upper respiratory infections over a period of fifteen years. Physical examination was non-contributory.

Roentgenograms revealed an ovoid density measuring 5 cm. in diameter, situated to the right of the spine between the first and second interspaces posteriorly (Fig. 3). On bronchoscopy, Oct. 2, the right main bronchus was found to be closed, and the mucosa in the left main bronchus appeared

red. There were no positive laboratory findings.

At operation, performed Sept. 16, 1949, a firm round mass measuring 5 cm. in diameter was discovered in the axillary segment of the right upper lobe. This mass was intimately adherent to the apical segment of the right lobar lobe, from which it could not be separated. There was no gross evidence of hilar lymphadenopathy. A pneumonectomy was performed.

Pathologic Report: The growth was identified as a bronchial adenoma with regional peribronchial lymph node metastases.

DISCUSSION

The roentgenologist is occasionally confronted with a chest film in which a solitary nodule is demonstrated. The differential diagnosis in these instances is difficult and may be impossible. A peripherally situated bronchial adenoma is one of the possibilities to be borne in mind. The presence of calcification in the nodule is considered to be a sign of a benign lesion. Calcification, however, does not always provide a basis for differentiation among the various benign growths. It is known that tuberculoma and hamartoma are sometimes calcified. One authentic case of a peripheral adenoma with calcification is as yet unreported (4). The various methods of investigating solitary lung nodules do not fall within the scope of this paper.

SUMMARY

The pathology of bronchial adenomas has been reviewed and correlated with the diagnostic roentgen findings. Three cases of bronchial adenoma of the peripheral type, which is regarded as uncommon, have been presented. In none of these was the diagnosis established until the resected specimen had been analyzed by the pathologist.

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SUMMARIO IN INTERLINGUA

Un Nota in Re le Caracteristicas Roentgenologic de Adenoma Bronchial del Typo Peripheric

Es presentate un revista del aspectos pathologic, clinic, e roentgenographic de adenoma bronchial. Es reportate 3 casos in que iste tumor occupava un sito peripheric. Adenomas peripheric, que es relativamente rar, produce nulle symptomas clinic. In omne le casos presentate le tumor esseva discoperite incidentalmente in un roentgenogramma thoracic. In omne le casos le diagnose debeva attender le analyse de un specimen de resection per

le pathologo. Le apparentia roentgenographic de iste crescentias depende de lor location anatomic. Le typo peripheric es visualisate como un densitate circumscripte con margines vagemente lobulate. In le visualisation de lesiones a sito central, bronchographia e bronchosopia es de valor. Adenomas bronchial debe esser differentiate ab carcinoma del pulmon, ab solitari metastases al pulmon, e ab varie lesiones benigne.

The Use of Visciodol in Bronchography¹

SAMUEL COHEN, M.D., HARRY J. PERLBERG, M.D., and C. R. LARDE-ARTHEZ, M.D.

FOR A GREAT MANY years, bronchiectasis was a clinical entity that was diagnosed mainly by symptoms, signs, and suggestive radiographic changes. Confirmation of this diagnosis was made possible in the early 1920's when Sicard and For-
estier (1) introduced Lipiodol in bronchography.

Although this contrast medium has been, and still is being, used successfully, there has been a steadily increasing demand for a radiopaque material that would have the advantages of Lipiodol—excellent opacity and non-irritability—but still would not penetrate to alveolar levels and could be quickly expelled from the lungs.

Visciodol, a mixture of Lipiodol and finely divided sulfanilamide, recently made available in the United States, has shown certain advantages compared to Lipiodol. Because of good results obtained abroad during the past five years with a similar suspension, we decided to investigate the properties of the American product. Our first studies with this medium were made in March 1954.

Although bronchography is recognized to be indispensable in the diagnosis of certain chest conditions, the use of iodized oil has certain disadvantages. It may reach the alveoli and may remain there for many weeks, months, or even years. Excessive alveolar filling may also obscure a bronchiectatic area. Moreover, the residual oil interferes with the proper interpretation of the status of the lungs in succeeding radiographic examinations. Mapping out of the bronchial tree is a prerequisite to consideration of resection for bronchiectasis and in some cases of tuberculosis. If "flooding" of the smaller bronchioles and alveoli occurs, making

interpretation of the films difficult, surgical intervention may have to be delayed for varying periods before bronchography can be repeated and more satisfactory roentgenograms obtained.

Dormer, Friedlander, and Wiles, in South Africa, first used Lipiodol-sulfanilamide (as it is known in Europe) for the treatment of bronchial dilatations in fibrotic cases of tuberculosis (3). Their primary purpose was to determine if sulfanilamide in an oily vehicle would be of therapeutic value. Surprisingly, the bronchograms obtained in the course of these studies showed remarkably improved clarity, and it was further noted that this material was eliminated much more rapidly than plain Lipiodol. Houghton and Ramsay (4) also used Lipiodol-sulfanilamide as bronchographic material and observed the same advantages. Their work was later confirmed in publications from several other countries (2, 5-10).

In the United States a study of forty bronchograms with Visciodol was recently reported by Burrascano (11), demonstrating the advantages of this medium over water-soluble and other bronchographic materials.

MATERIAL AND METHODS

Visciodol is an opaque, whitish, viscous liquid available in 15 c.c. vials. It is composed of finely divided sulfanilamide suspended in 40 per cent Lipiodol, with a very small amount of sodium sulfite added as a preservative. The sulfanilamide content is considerably less than any therapeutic—not to say toxic—dose, and virtually all of it is recovered by postural drainage and expectoration following the examination.

¹ From the Departments of Medicine and Roentgenology, B. S. Pollak Hospital for Chest Diseases, Jersey City, N. J. Accepted for publication in May 1956.

Visciodol used in this study was supplied by E. Fougera & Co., Inc., New York, N. Y.

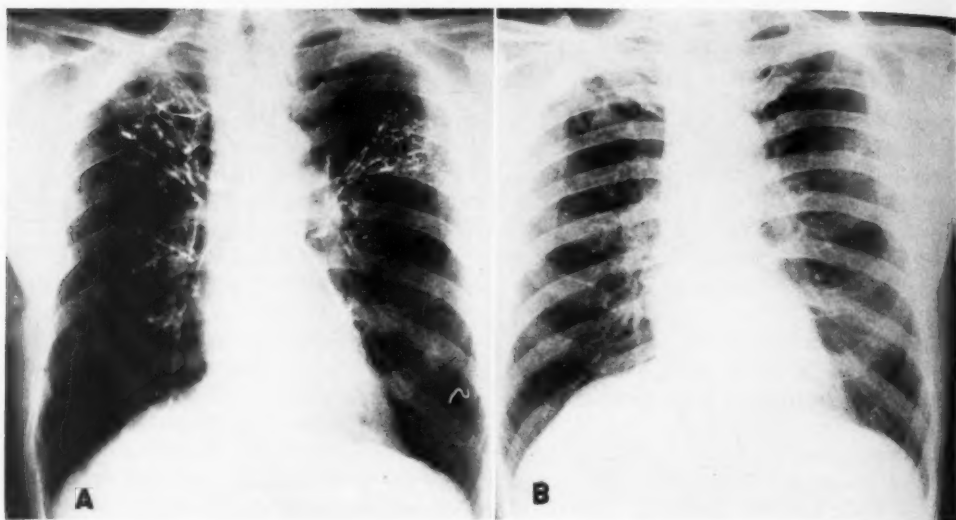


Fig. 1. A. Outline of cavity in right upper lobe by Visciodol, Feb. 25, 1955. B. Complete elimination of contrast medium from right upper lobe four days later, March 1. A trace remains in the left upper lobe.

The formula is as follows:

Sulfanilamide	0.32 gm./c.c.
Sodium sulfite	0.002 gm./c.c.
Lipiodol (iodized oil) 40 per cent q.s.	1.0 c.c.

TECHNIC

There are certain technics that should be learned in the utilization of Visciodol. Because it is a suspension, it has a tendency to separate and should be vigorously stirred with the glass rod that accompanies each vial until a homogeneous re-suspension is obtained.

The viscosity of the product is more than three times that of Lipiodol, and for this reason alveolar penetration is uncommon. To preserve this high viscosity, with its advantages, Visciodol should be used at room temperature. Warming tends to increase fluidity.

Methods for positioning the patient and instilling Visciodol are the same as for Lipiodol, except that less topical anesthesia is probably required.

Visciodol differs from other contrast media in the length of time required to reach the predetermined field of examination. Because of its high viscosity and resultant slow-flowing characteristics, no

haste is necessary between its administration and x-ray exposure; from five to fifteen minutes are available for positioning of the patient. The progress of the radiopaque material should be observed fluoroscopically. Because the rate of flow is slow, caution must be observed lest an excessive amount be introduced. If this occurs, overfilling may result, with the possibility of alveolar penetration.

After bronchography, the patient is placed posturally so that the Visciodol is eliminated from the lungs. In the majority of cases the bulk of the radiopaque material has disappeared in from forty-eight to seventy-two hours.

PATIENTS, PERSONNEL, AND PROCEDURES

From March 1954 to February 1956, we performed 82 bronchographic studies with Visciodol. Our series included tuberculous and non-tuberculous suspected bronchiectasis, hemoptysis of undetermined origin that sometimes constituted the only symptom, with negative roentgen findings, and a small heterogeneous group. After the bronchogram, chest films were obtained at intervals, supplemented by

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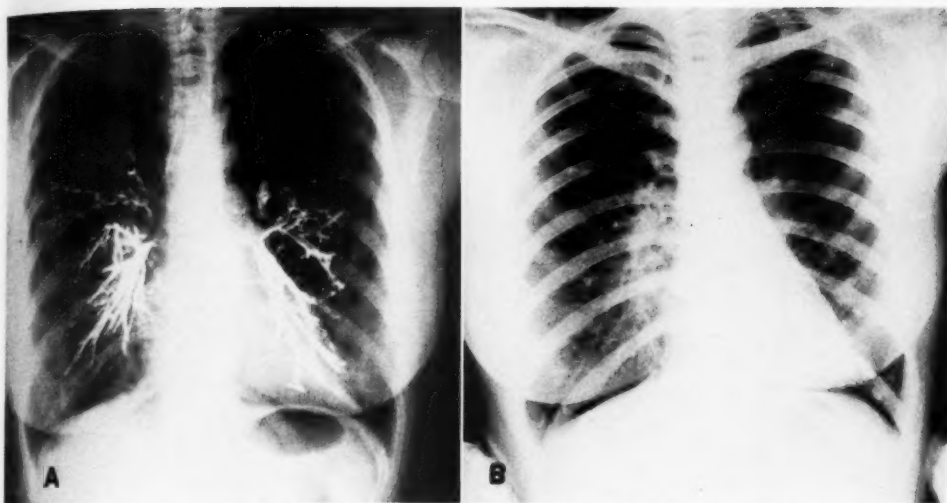


Fig. 2. A. Cylindrical bronchiectasis of the lower lobes demonstrated by Viscidol, Dec. 10, 1954. B. Virtually complete absence of contrast medium four days later, Dec. 14.

fluoroscopic examinations to determine the rate of elimination of this material.

Our routine orders for bronchography are:

1. Postural drainage on the morning of the procedure if the sputum is excessive in amount. When secretions are too abundant, a course of antibiotic therapy prior to the procedure is often invaluable to diminish them and in this way permit the free flow of the oil in the bronchi.
2. Nembutal gr. $1\frac{1}{2}$ the previous evening and again two hours before bronchography.
3. Light breakfast (tea and toast).
4. No lunch.
5. Codeine phosphate gr. $\frac{1}{2}$ with atropine sulfate gr. $\frac{1}{100}$ or $\frac{1}{150}$ according to weight, to be given hypodermically on call when the anesthesia is about to be begun.
6. Postural drainage after bronchography is completed.

The anesthetic used is Butyn Sulfate in an atomizer. When the pharynx, larynx, and tracheobronchial tree are anesthetized, a nasal catheter is passed into the trachea and the patient is then placed on a radio-scopic tilting table. This permits positioning to facilitate the entrance of the opaque material into the desired areas.

Ten to fifteen cubic centimeters of Viscidol are generally sufficient, depending on the extent of the area to be mapped.

A solution of Sodium Pentothal in a

syringe for immediate use is always on hand in case an anesthetic reaction occurs.

There is no absolutely dependable method to determine sensitivity to the anesthetic employed, to iodides, or to sulfanilamide. If sensitivity is suspected from the past history, some operators prefer the use of ACTH before anesthetization.

RESULTS

In our 82 cases, we found that the opacity obtained with Viscidol was equally as good as that with Lipiodol, giving a clear picture of the bronchial tree. The material proved to be non-irritating and in this respect compared favorably with our earlier wide experience with Lipiodol.

Elimination was exceptional. Much of the Viscidol was expectorated within the first twenty-four hours, and complete clearing, as shown roentgenologically, occurred in from three days to two weeks in the great majority of instances. In a small percentage, specks of opaque material remained and disappeared more slowly, but very seldom were they numerous enough to interfere with the clarity of a repeat bronchogram of the same area or to obscure pulmonary changes on follow-up x-ray films or fluoroscopic examina-

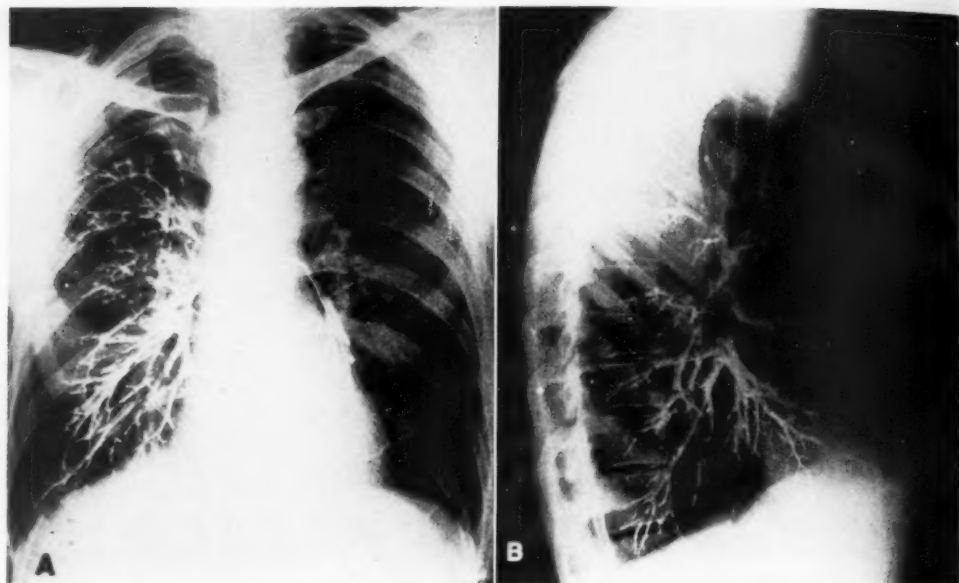


Fig. 3. A and B. Bronchograms obtained with Visciodol, demonstrating complete filling and high contrast values.

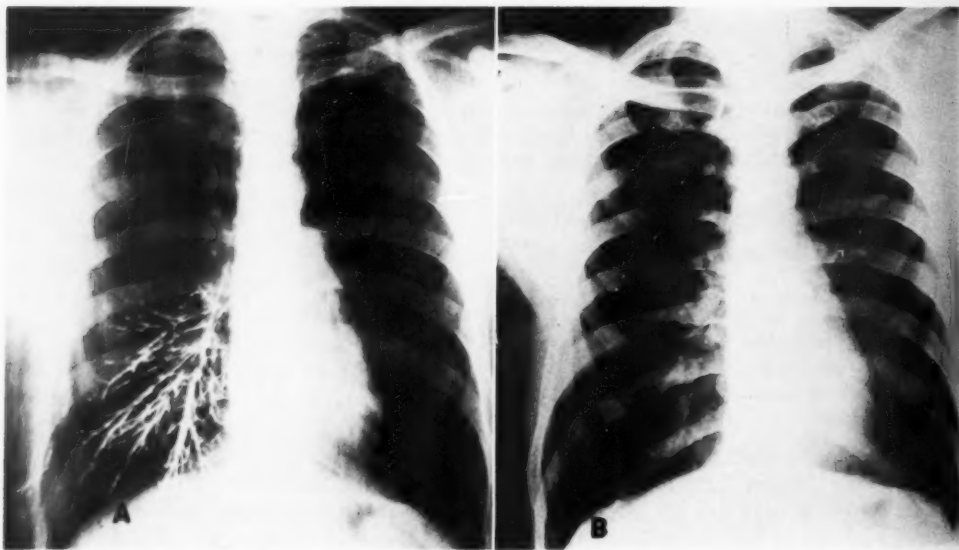


Fig. 4. A. Visciodol bronchogram, July 28, 1955. B. Virtually complete elimination of medium by the following day, July 29.

tions. In a few cases, alveolar penetration occurred, especially during very hot summer days, when the elevated room temperatures sharply reduced the normal viscosity of the medium.

In none of our cases did we observe any untoward effects. However, one should be alert and ready to cope with possible manifestations of sensitivity to the anesthetic used, to iodide, or to sulfanilamide.

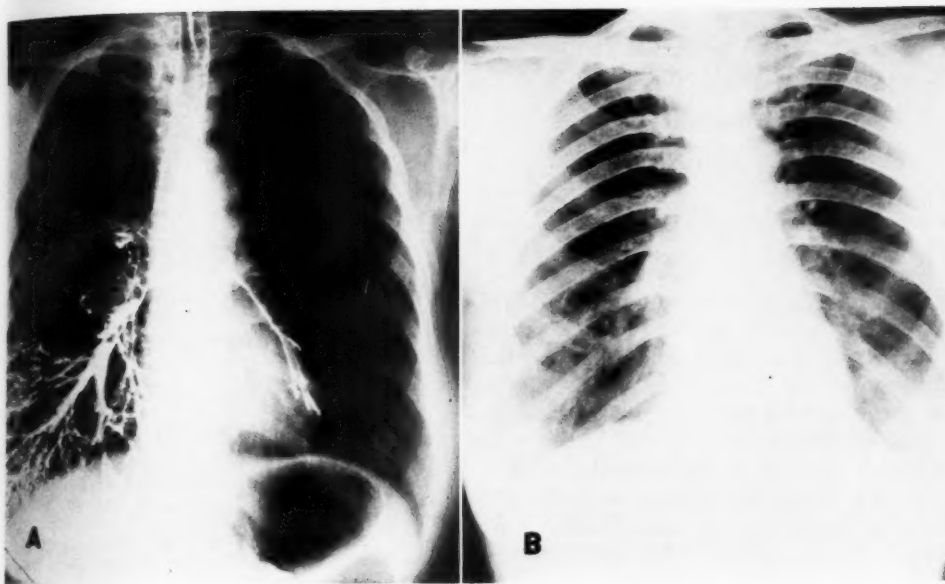


Fig. 5. A. Viscidol bronchogram, April 23, 1954. B. Complete disappearance of medium by May 10.

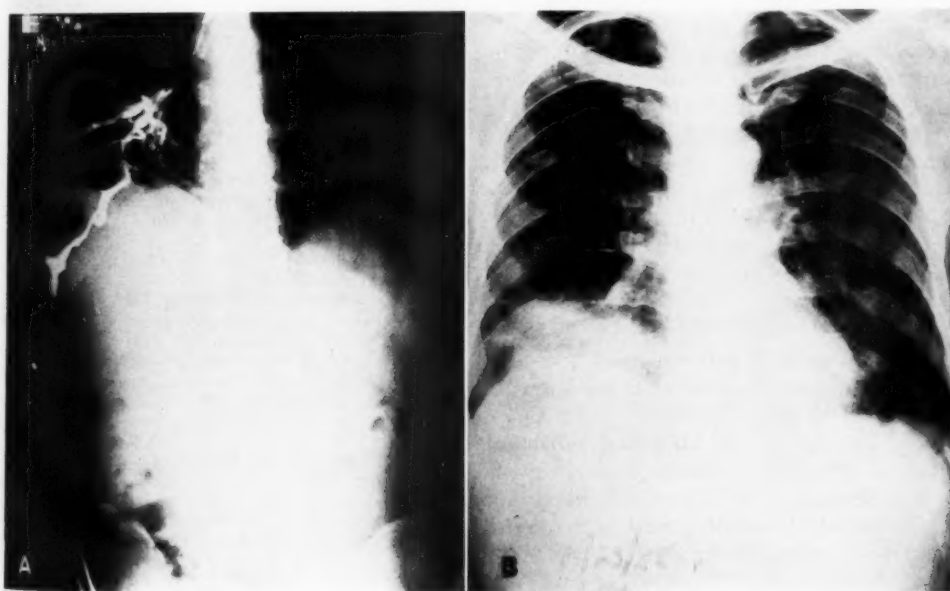


Fig. 6. A. Viscidol study demonstrating a bronchobiliary fistula following cholecystectomy. Patient expectorated bile-stained sputum. Note air and fluid level below the diaphragm. B. Complete elimination of the medium in five days.

It should be mentioned that Salinger and Houghton (5) have performed more than 7,000 bronchograms with the Lipiodol-

sulfanilamide mixture without any complications.

Included are some reproductions of

roentgenograms from our series to illustrate the clarity of the bronchial outline with Visciodol and its rapid elimination.

COMMENT

Powdered sulfanilamide acts as a thickening agent when added to Lipiodol. The product, known as Visciodol, has proved to have definite advantages over other opaque media for radiographic visualization of the bronchopulmonary field. The blandness of the suspension assures absence of irritation, which is of great importance in thoracic disorders. Owing to the increased viscosity of this mixture, tissue surfaces are well coated, but alveolar filling is avoided in the majority of cases, and the bronchial outlines can therefore be visualized with greater clarity. Because of the physical characteristics of the preparation, its elimination from the bronchopulmonary system is greatly accelerated. In general, this permits subsequent radiologic procedures in a comparatively short time, with the advantage of an unclouded film, unaffected by residual shadows from a previous instillation.

The amount of sulfanilamide used for a bronchogram is safe, especially in view of the rapid expectoration of the major part of the material, which is expelled from the lungs so promptly that it cannot cause any harmful effect.

SUMMARY

1. Visciodol, a suspension of powdered sulfanilamide in Lipiodol, has been used in a series of 82 bronchograms.
2. Clarity of the bronchial outline is greater than with Lipiodol.
3. Because it is three times as viscous as Lipiodol, Visciodol very infrequently descends to the alveolar level.

4. Visciodol is rapidly eliminated from the bronchopulmonary passages, usually in from forty-eight to seventy-two hours.

5. Successful repeat bronchograms and fluoroscopic examinations can usually be obtained within a week after initial instillation, with no halo effect from residual contrast medium.

6. Visciodol is not irritating to the bronchial mucosa.

7. No untoward effects were observed.

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SUMMARIO IN INTERLINGUA

Le Uso de Visciodol in Bronchographia

Sulfanilamido pulverisate age como spissificante quando illo es addite a Lipiodol. Le producto resultante, cognoscite como

Visciodol, se ha provate definitivamente superior a altere medios de opacification pro objectivos de visualisation radiographic

in le campo bronchopulmonar. Le dulcor del suspension assecura le absentia de irritation, lo que representa un avantage importante in disordines thoracic. In consequentia del augmentate viscositate del mixtura, superficies de tessuto es ben revestite, durante que repletion alveolar es evitate in le majoritate del casos, e le contornos bronchial deveni ergo plus claramente visualisabile. A causa del characteristics physic del preparato, su elimina-

tion ab le systema bronchopulmonar es grandemente accelerate. In general, isto permette le repetition de un manovra radiographic post un intervallo de relativamente breve duration, sin risco de obnubilation del pellicula, sin umbras residue ab previe instillationes.

Le autores basa lor reporto super 82 studios bronchographic executate per medio de Viscidol. Nulle effecto adverse esseva notate.



The Reversal of Advanced Bronchiectasis¹

JOHN R. PONTIUS, M.D., and LEWIS G. JACOBS, M.D.

REVERSIBLE bronchiectasis or pseudo-bronchiectasis has been reported by a number of authors. The cases have been limited largely to the acute and subacute phases of the disease, most often following an acute pneumonia; all have been of the cylindrical type. The reversal of mixed saccular and cylindrical bronchiectasis of considerable duration and chronic symptomatology, under medical management, has not to our knowledge been the subject of report. Such a case is recorded here.

The mechanism of the production and reversal of the more acute types of bronchiectasis has been fully discussed by Mallory (4), and by Fleischner (2), who approached the problem from a theoretical point of view. Their discussion does not appear pertinent to our case, since it is based principally on the cylindrical type of disease. Finke (1) does indeed mention the observation of saccular changes in cases lacking microscopic evidence of destructive bronchial lesions, but he also notes his belief that this condition, once it has existed for several months, is no longer reversible.

CASE REPORT

A 23-year-old white male was admitted because he had been told on discharge from military service that he needed a lobectomy for bronchiectasis. He gave a history of frequent chest colds during his high-school years and hay fever in 1950. He had attempted to enlist in military service in 1952 and 1953, but was rejected, chest films having been abnormal on both occasions (Fig. 1). He finally entered service in January 1954. In September 1954 he had pneumonia and was hospitalized for thirty-nine days because of slow resolution. Right bronchography attempted at this time was reported as unsatisfactory. Abnormal bronchograms, showing saccular and cylindrical bronchiectasis, were obtained, however, in November 1954 (Fig. 2) and again in January 1955 (Fig. 3). The patient was discharged from service with a diagnosis of bronchiectasis and thereafter brought up about a third of a cupful of yellowish thin sputum per day. He never had hemoptysis.

¹ Accepted for publication in August 1956.



Fig. 1. Induction photoroentgenogram, Aug. 25, 1953. Note small area of pneumonitis in right base.

Physical and laboratory examinations revealed nothing of significance. The white cell count was 10,650, with 56 per cent polymorphonuclear leukocytes, 32 per cent lymphocytes, 7 per cent monocytes, and 5 per cent eosinophils. Post-bronchoscopic sputum cultures, including special cultures for fungi, were negative. Bronchoscopy was non-contributory. Bronchography performed at this hospital on Sept. 1, 1955 (Fig. 4), was followed in forty-eight hours by a generalized giant urticarial rash, thought to be attributable to Dionosil. The patient stated at that time that he had similar but milder reactions to Lipiodol on the occasion of his first and second bronchograms. He responded to Meticorten, but not to antihistaminics.

Following presentation of the patient at a chest conference, re-examination was recommended for better demonstration of the right middle and lower lobes. In order to insure good filling and to control allergic manifestations, preliminary treatment as outlined below was agreed upon.

The patient had received 50 mg. of pyribenzamine three times a day and daily intramuscular injections of 1 c.c. of 1/500 epinephrine in oil from Sept. 12 to 30, and 25 mg. ACTH gel intramuscularly twice daily from Sept. 15 to 30, to control his first reaction. He was placed on furlough, and consequently received no medication from Sept. 30 to Oct. 20. He discontinued smoking during this time. Preparation for the final bronchogram began on Oct.

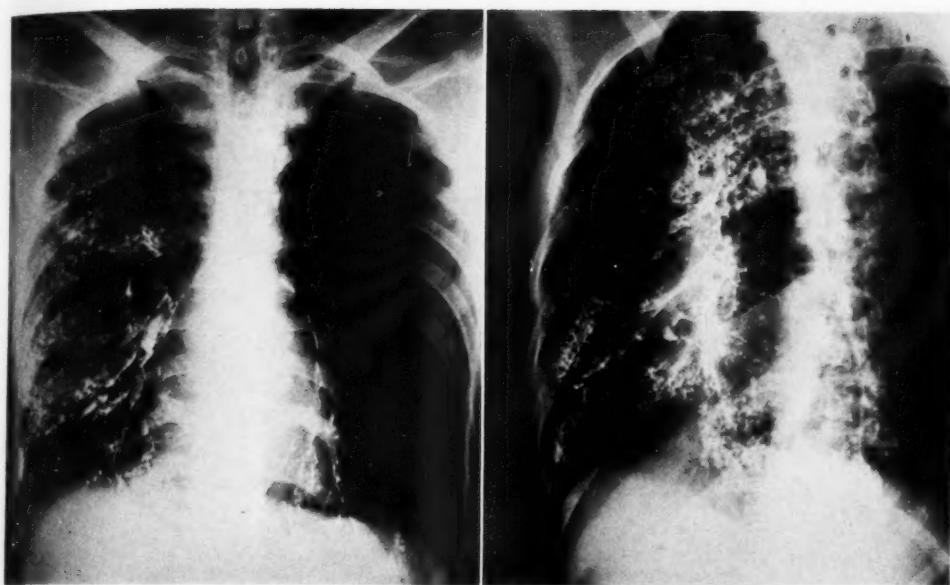


Fig. 2. Postero-anterior and oblique bronchograms, Nov. 18, 1954.

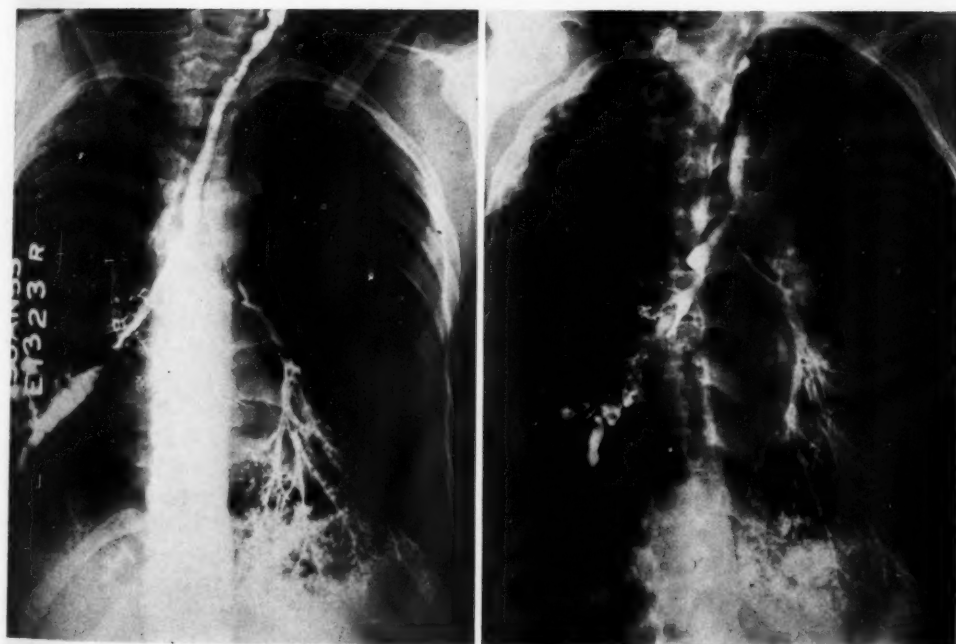


Fig. 3. Postero-anterior and oblique bronchograms, Jan. 19, 1955.

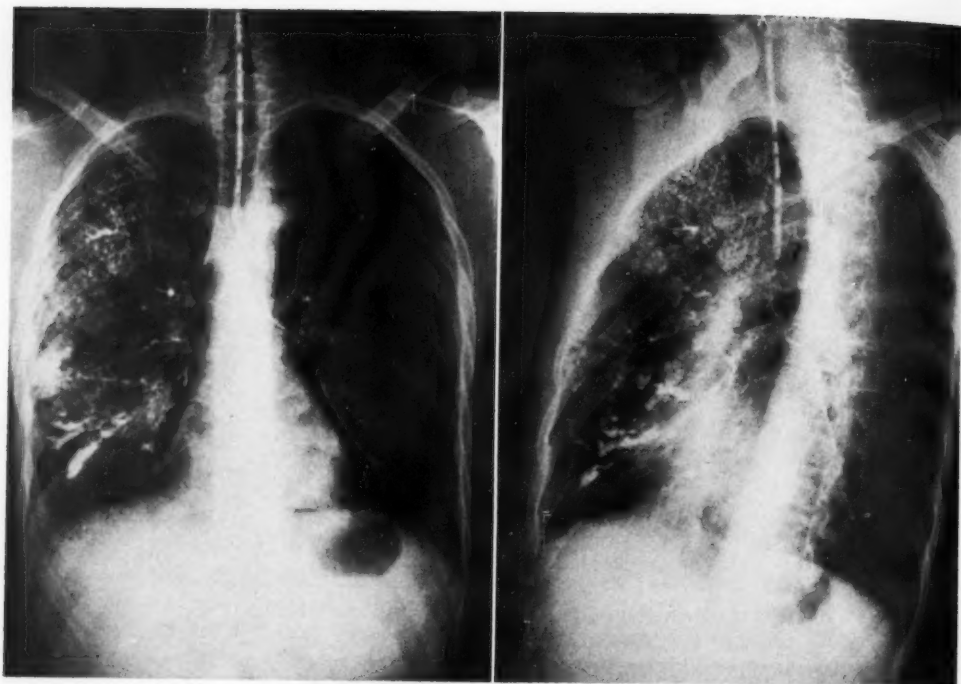


Fig. 4. Postero-anterior and oblique roentgenograms, Sept. 1, 1955.



Fig. 5. Postero-anterior and oblique bronchograms, Nov. 4, 1955.

27 and continued to Nov. 4. Nebulized inhalations of a mixture of 100,000 units of aqueous penicillin and 1 c.c. of isoprel were given four times daily, and the patient was directed in careful postural drainage and coughing to empty the right lung of secretions four times daily. To this regimen, 50 mg. of benadryl four times daily and injection of 20 mg. of ACTH gel intramuscularly twice daily were added on Nov. 3. One hour before bronchography 5 mg. of chlortrimeton was given intravenously. After bronchography (Nov. 4) the patient was maintained on 20 mg. ACTH gel intramuscularly twice daily. In spite of these measures, an urticarial eruption developed on the lower trunk and thighs on the fifth day, clearing rapidly, however, after adrenalin administration. For both bronchographies at this hospital Dionosil was used, while the two done in the army were said to have been performed with Lipiodol.

The bronchograms obtained on our second study (Fig. 5) were interpreted as normal, and the patient was discharged and followed on an out-patient basis. On Feb. 27 he was bringing up a quarter of a cup of sputum daily but was otherwise asymptomatic. The sputum was thin and white or yellowish. On Aug. 29 he was asymptomatic and bringing up only traces of sputum. He had had no colds since his discharge, the longest cold-free period for years, and was working regularly as a filling station attendant. Physical examination showed only a few coarse basal rhonchi disappearing on cough. The chest film still showed a minimal increase of basal markings on the right.

On reviewing the films from this case with various consultants, a variety of opinions was obtained, from question of the identity of the patient to the belief that the dilated areas may have been unfilled on the last bronchogram. A careful study of the films has convinced the authors that the patient is indeed the same, as evidenced by comparison of the bony structures on the roentgenograms. Furthermore, he was checked with especial care by one of the authors because of concern over the allergic reaction, and there was no question that the same patient was examined on both

occasions at this hospital. As to the filling of the bronchi, careful study of the two sets of bronchograms has convinced us that at least some and probably all of the previously abnormal segments were filled on the second study and had reverted to normal caliber. In view of the patient's severe allergic reactions, further studies were not considered justifiable.

SUMMARY

A case is reported in which abnormal pulmonary densities were observed in 1953 and abnormal bronchograms, showing bronchiectasis of cylindrical and saccular type, were obtained in 1954 and 1955. Severe chronic bronchographic abnormalities existed for at least ten months under observation. Complete reversal of these changes followed two months of intensive medical measures. Whether or not this reversal is related to the management or to some external cause cannot be determined. The permanence of the clearing is also open to question. Although no adequate theoretical explanation is available, so startling a finding seemed worthy of record.

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SUMMARIO IN INTERLINGUA

Reversion de Bronchiectasis Avantiata

Le autores reporta un caso de sever bronchiectasis del typo sacculo-cylindric combinate, demonstrate per bronchographia in un masculo de 23 annos de etate.

Le manovra bronchographic, executate per medio de Dionosil, esseva sequite per un sever reaction urticarial. Le repetition del manovra duo menses plus tarde resultava

in bronchogrammas normal. Il existe reportos del reversion de bronchiectasis cylindric, sed le examine del litteratura ha revelate nulle previe caso de un reversion de chronic bronchiectasis del typo sacculo-cylindric combinate.

A fin de prevenir un repetition del reaction urticarial e etiam pro meliorar le replenation, le patiente esseva subjcite a un regime special durante le intervallo ab le prime usque al secunde examine. Isto includeva le inhalation, in forma nebulisate, de penicillina e isopral, drainage postural, e tussir pro evacuar le secretiones pulmonar. Benadryl e gel a ACTH esseva

administrate le die ante le secunde studio, supplementate per Chlor-Trimeton un hora ante le injection del substantia de contrasto. Le uso de gel a ACTH esseva continue post le completion del studio, sed in despecto de omne le mesuras preventive, un eruption urticarial occorreva. Illo respondeva a adrenalina. Le patiente ha experientiate un continue melioration symptomatic usque al tempore del presente reporto. A causa del sever reactiones, additional investigationes bronchographic esseva considerate como contraindicate. Le rolo del medication in le reversion del alterationes pulmonar non es cognoscite.



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The Use of Different Tube Shifts in Lung Tomography¹

HANS SALINGER, M.D., and HANNAH FRIEDMAN-BAROU, M.D.

THE PROBLEM OF the incompletely blurred shadows produced in tomography is as old as the method itself. A number of measures have been tried to eliminate them, but none has proved wholly successful. Increased blurring of unwanted shadows is obtained in circular or spiral movement of the tube-film system, but they have not been entirely lost. In the practice of tomography, the rectilinear tube movement is usually preferred, especially in examination of the lung. This preference is based on the shorter exposure time and the larger area demonstrated as compared with other forms of tube shift. Apart from this, the necessary apparatus is simpler and cheaper.

Usually the rectilinear movement is directed at an angle of 45 to 90° to the long axis of the object whose shadow is to be eliminated. In pulmonary tomography the most disturbing shadows are those of the horizontal parts of the ribs, and the craniocaudal direction of shift is therefore generally accepted. Most problems are elucidated in this way, but there remain some for which a satisfactory answer remains to be found. Greineder recommends the oblique shift for some examinations of the mediastinum, and Lodin makes the same recommendation for examination of the intrapulmonary bronchi. De Vulpian, in an article on tomographic attachments, mentions a case in which different directions of shift were employed.

Among the problems not satisfactorily solved by rectilinear pulmonary tomography is the examination of small parts. Their tomographic visualization is deficient as a result of superimposed blurred shadows; only the extension of the process within the lung field is better shown in this way (Bronkhorst). Similar difficulties may be encountered in tomographic demon-

stration of larger parts of the lung if, in the neighborhood, there are x-ray-absorbing structures whose long axes coincide with the direction of the tube shift. This holds true not only for examinations of the mediastinum or the intrapulmonary bronchi, mentioned above, but also for the apices, etc. In such cases we have added an oblique tube-film shift to the routine craniocaudal shift. This simple measure has been used for over ten years in our daily routine work and has often afforded valuable additional information.

TECHNICAL CONSIDERATIONS

It is to be remembered that tomographic unsharpness is a consequence of incomplete blurring of shadows of objects situated at a short distance from the layer of interest. Whether a blurred shadow remains or whether it is eliminated more or less completely depends on several factors:

1. The distance between the object casting the shadow and the section plane. Increased distance results in more complete blurring.

2. The x-ray absorbing power of the object. The denser the shadow the more difficult it is to eliminate.

3. The length of the tube-film shift. The greater the movement, the better the blurring.

4. The direction of the long axis of the object whose shadow is to be eliminated. When this axis is parallel to the tube-shift, elimination of its shadow is more difficult and often impossible.

The first and the second factors cannot be influenced. As to the third, length of the tube-film shift, there is a limit to the extent to which this can be increased, since further thinning of the demonstrated layer diminishes the contrast, so that one of the basic laws of roentgenographic demon-

¹From the X-Ray Diagnostic Department (Chief Dr. Hans Salinger) of the Beilinson Hospital (Workers Sick Fund of the Jewish Federation of Labour in Israel), Petah Tikvah, Israel. Accepted for publication in July 1956.

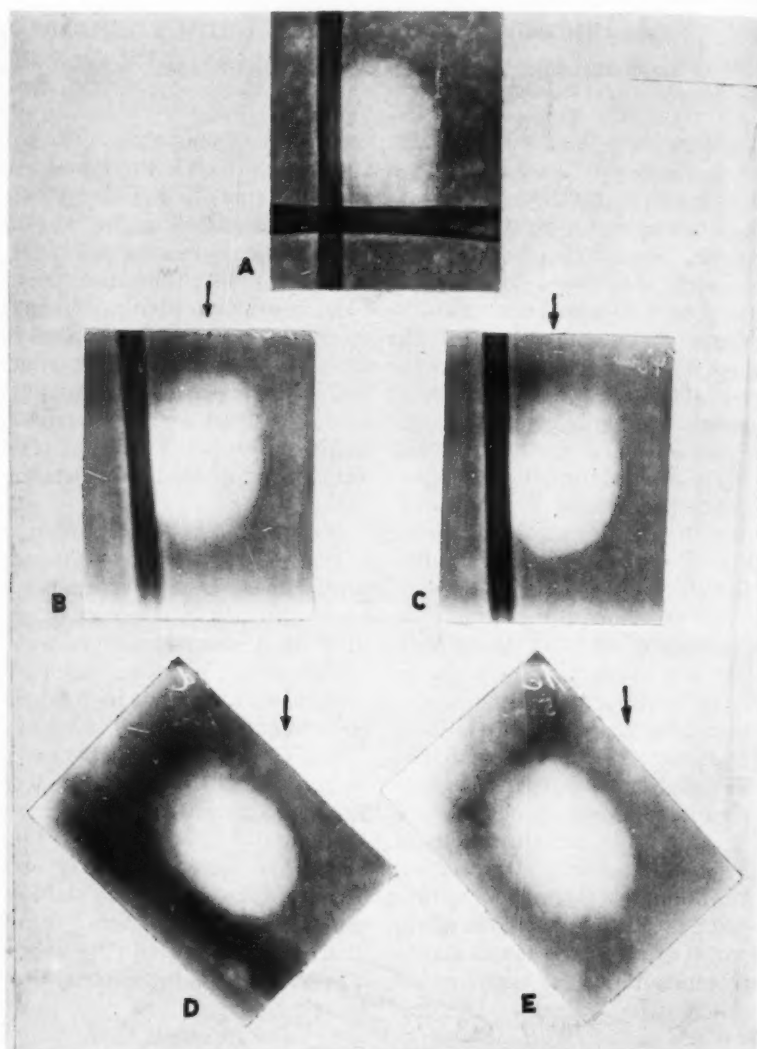


Fig. 1. Experimental study with a paraffin block on top of which two bones were laid at right angles to each other. A. Routine roentgenogram. B and C. Tomograms—layers 4 and 5 cm. from the top, respectively—made with the tube shift in a direction parallel to the long axis of one of the bones. D and E. Tomograms of the same layers obtained with the block turned at an angle of 45° to the direction of the tube shift.

stration—"distinctness depends on the balance between contrast and sharpness"—would be infringed. To keep the balance between contrast and sharpness in lung tomography with rectilinear tube-film shift, a maximum angle of 50° between the central-ray positioning at the beginning and the end of the shift (angle of oscilla-

tion) should not be exceeded. In addition to increasing the contrast, soft x-rays and a secondary grid are to be used. The experiments of Bronkhorst, Ziedses des Plantes, and others have indicated the limitation to thinning out of the tomographic layer.

The fourth factor affecting the tomo-

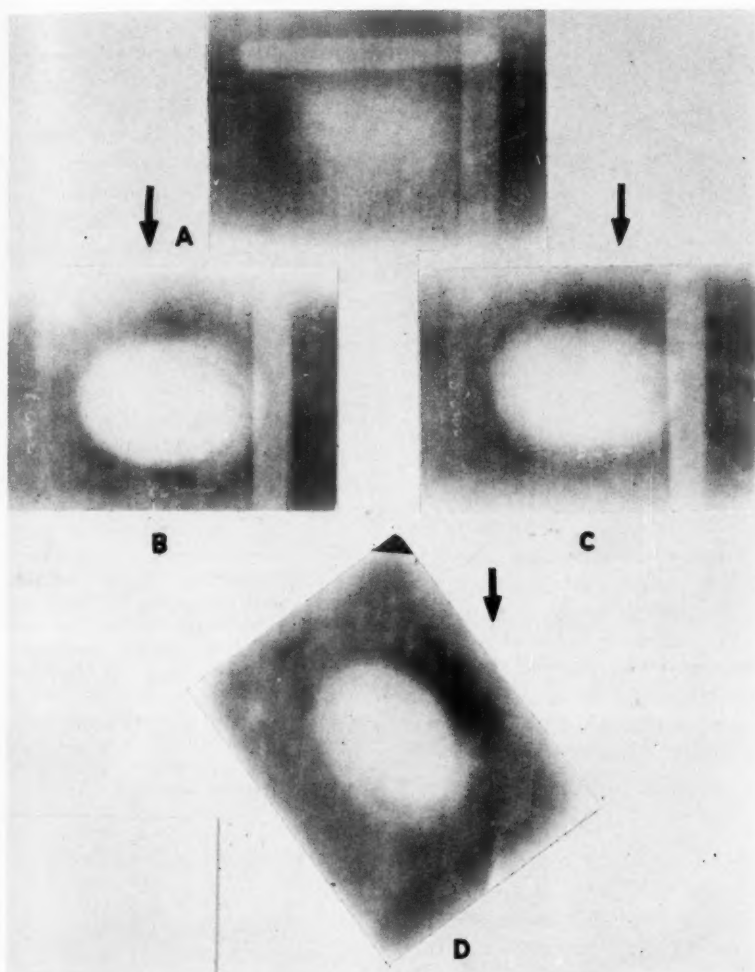


Fig. 2. Same experiment as illustrated in Fig. 1, except that air-filled grooves, casting shadows, replace the bones.

graphic blurring of a shadow is the relation between the direction of the tube-film shift and that of the long axis of the shadow-casting body. This factor may be influenced by the changing of one of the directions. Unquestionably this is best done by using a curved line of shift, but this is possible only with special apparatus.

To demonstrate this factor in a simple manner, a paraffin block, $6 \times 8 \times 10$ cm., was used. In the middle of the block a cavity was hollowed out and on top of the block two long bones were laid at right

angles to each other. On a routine x-ray film the two bones cover the borders of the cavity on two adjacent sides (Fig. 1, A). A tube shift in the direction of the long axis of one of the bones resulted in elimination of the shadow of the second one, but the first did not disappear. This was seen in two different layers, 4 and 5 cm. from the top (Fig. 1, B and C). After the block had been turned 45° to the tube-shift direction, one bone shadow disappeared entirely in the 4-cm. layer, while the second one was nearly blurred out

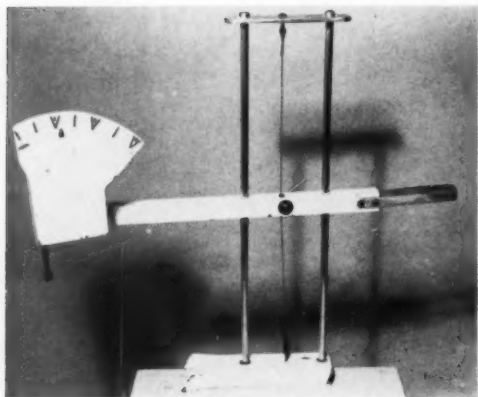


Fig. 3. Apparatus for control of respiratory movement.

(Fig. 1, D). At 5 cm. (Fig. 1, E) neither shadow could be seen.

The experiment was repeated, under the same conditions, after replacement of the two bones by two grooves on the block surface. The negative shadows of these air-containing grooves showed the same tomographic effects (Fig. 2, A-E) as the positive bone shadows. In this experiment the negative shadows were also invisible with an oblique tube shift.

TECHNIC OF EXAMINATION

In the beginning of our studies, a home-made planigraph was used. Later we employed a Picker tomograph, constructed according to the principles of Grossmann. No distinct difference in results could be observed. In turning the patient into the oblique position care must be taken that the new direction of shift does not coincide with the long axis of a structure in the surrounding tissue whose blurred shadow may cover the area to be examined. In performing the examination, two essential points are to be watched: (a) The incidence of the central ray must be the same in all tomograms. This is easily achieved by marking the point of incidence upon the skin of the patient. (b) The respiratory expansion of the lung must be the same in all tomograms. Otherwise, the layer demonstrated by the tube shift may not be the same as that

shown by the craniocaudal shift. The expansion of the lung is controlled by a simple device, in which a movable knob is connected to a pointer (Fig. 3). This device is so placed that the knob touches the skin of the side not being examined, in expiration. The expanding thorax pushes the knob upward. The degree of expansion is controlled by reading the turn of the pointer and can thus be reproduced in every exposure.

CASE REPORTS

Three cases have been selected illustrating typical results obtained by the above mentioned method.

CASE I: The patient was a 23-year-old man with long standing tuberculosis of the right upper lobe. *Tomography*, performed with a craniocaudal tube shift, showed in layer 10 a small cavity with a thick wall in the medial paramediastinal area of the apex. A large non-homogeneous infiltration was evident in the medial and lateral area at the same level. The lateral part of this shadow, however, was partially covered by the incompletely blurred shadow of the anterior part of the first rib (Fig. 4A). On an additional tomogram of the same layer with oblique tube shift (cranial right to caudal left, Fig. 4B), the paramediastinal cavity was better defined, the interfering shadow being eliminated entirely. A second small cavity in the lateral infiltration, not previously seen, was demonstrated, as well as an emphysematous zone between the pleura and the infiltrate.

CASE II: A 46-year-old man was known to have had tuberculosis for sixteen years. In December 1945, a cavity with a thickened border was demonstrated by tomography in the left upper lobe (Fig. 5A). Thoracoplasty was performed, but tubercle bacilli were found in the sputum thereafter.

In March 1947, new tomograms showed a thick and dense shadow in the same layer as the cavity found before operation, but no cavity could now be demonstrated (Fig. 5B). As the density might represent a lung scar as well as the incompletely blurred shadows of regenerated bone, a second film was taken of the same layer, but with a change of the tube-shift direction from craniocaudal to oblique (from cranial left to caudal right). After complete elimination of the bone shadow a cavity became visible, of the same shape as that seen before the operation, but rather narrower as a consequence of the compression (Fig. 5C).

CASE III: A 27-year-old woman had tuberculosis of the right upper lobe. Tomograms, made two

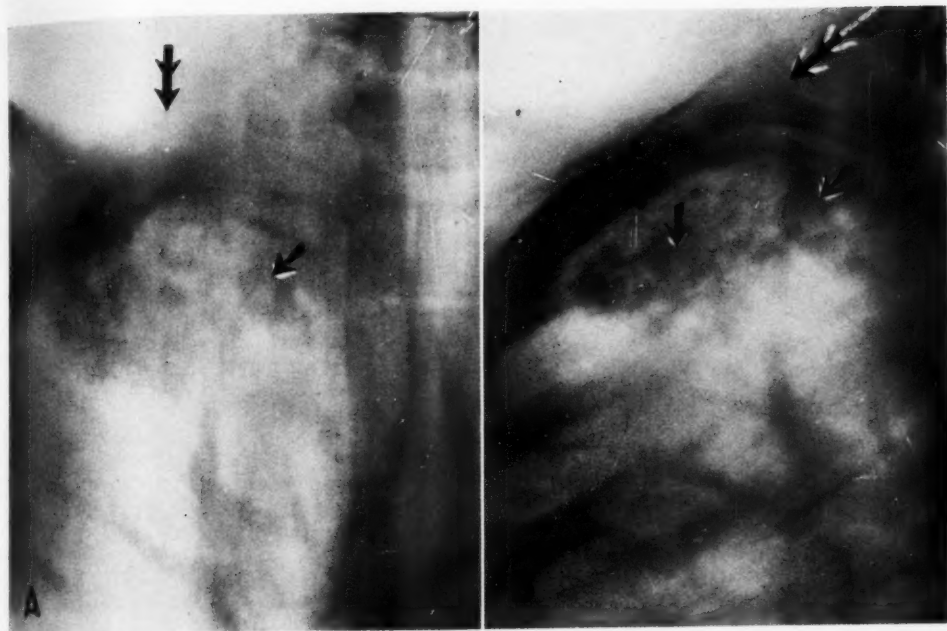


Fig. 4. Case I. The incompletely blurred shadow in the tomogram obtained with a craniocaudal shift (A) disappears when the patient is turned 45° (B) and a small cavity is demonstrated.

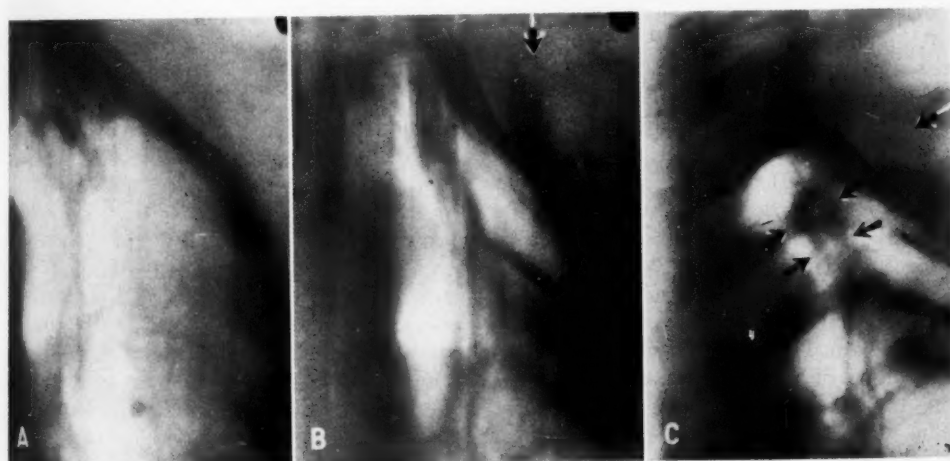


Fig. 5. Case II. A. Cavity demonstrated tomographically before operation. B. Incompletely blurred shadows of regenerated bones following thoracoplasty. No cavity is visible. C. Disappearance of partially blurred shadows and demonstration of a cavity after the patient was turned 45° .

years after a thoracoplasty, showed what appeared to be a longish cavity in layer 8, between many dense shadows, probably produced by regenerated bone (Fig. 6A). To exclude an incidental gap between the bones which might explain such a picture, an oblique tomogram at the same level was made (Fig. 6B). The shift was now cranial right to

caudal left. The appearance of the cavity, of the same size and shape, in both projections affords proof that it was responsible for the appearance rather than a tomographic artefact.

DISCUSSION

These 3 cases are illustrative of results

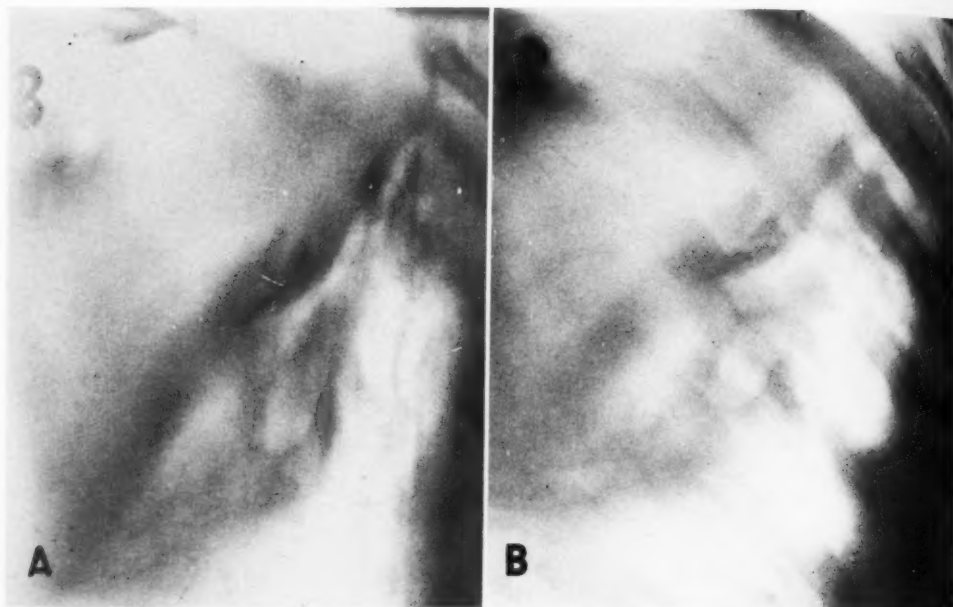


Fig. 6. Case III. Persistence of cavity with change in direction of tube shift, excluding the possibility of a tomographic artefact.

obtained by using more than one direction of the tube-film shift. An existing structure or cavity demonstrated with a craniocaudal shift appears similar in size and shape with an oblique shift (Case III), provided a new half-blurred shadow does not cover it. It is of primary importance, however, that the central ray impinges on exactly the same point in both tomograms, those made with craniocaudal shift and those in the oblique direction. The demonstrability of inclined or curved surfaces, such as the walls of a cavity, depends on the angle of incidence of the central ray on the examined surface (Bronkhorst). The shift of the central ray to another point may change the angle as a consequence of the conical expansion of the ray beam. A simple measure to avoid this undesired change of angle is described above under Technic.

The apex is the narrowest part of the lung and is surrounded by longish structures in a horizontal as well as a craniocaudal position. The anterior part of the first rib, the mass of the upper mediastinum

and the medial border of the scapula are directed craniocaudally and are prone to produce incompletely blurred shadows in craniocaudally directed shifts. Case I demonstrates the advantages of the use of different shift directions for gaining better and more details. Adler, employing the craniocaudal rectilinear shift in the anteroposterior and lateral projections for tomographic demonstration of the lung segments, adds the method described above, especially if the apices and the paramediastinal region are to be examined. He sees the borderline of the foci more distinctly and thinks that the differentiation of the blood vessels, especially those of the posterior segment, is much better.

Thoracoplasty, resulting in a narrowed chest cavity surrounded by regenerated bone having a predominantly craniocaudal direction, creates tomographic conditions similar to those in the lung apex. Case II demonstrates the finding of a cavity remaining after operation but not shown either in routine roentgenograms or tomograms obtained with a craniocaudal shift.

Not until oblique tube shift was employed could the shadows of the regenerated bone be blurred out sufficiently to permit visualization of the cavity. Here the change of direction proved to be of extreme diagnostic value. The same considerations are pertinent in other deformities of the chest, *e.g.*, in kyphoscoliosis.

Sometimes findings were encountered that could be cleared up as pseudopathological, *i.e.*, tomographic artefacts. In one case seen by us, two curved lines appeared in the craniocaudally directed tomogram, forming an angle medially and laterally, connected by a craniocaudally directed shadow, thus giving the impression of a cavity. Because of the possibility that the lateral border might be an incompletely blurred shadow of the scapula, the second direction of shift was added, proving that it was the scapula that actually caused the erroneous picture of a cavity. We have made it a rule that a ring-like shadow seen in rectilinear tomography must be proved as real, if according to anatomical considerations a part of its borderline may be due to an incompletely blurred shadow. That such a decision is very important and justifies the additional examination is obvious.

CONCLUSIONS

In tomography performed with rectilinear shift the incompletely blurred shadows of structures with a long axis in the same direction as the shift may obscure impor-

tant findings and prevent their recognition. This fact, well known from the early days of tomography, has led to the construction of apparatus with curved shifts. Most practical work, however, continues for various reasons to be performed with a rectilinear shift. Special consideration as to the formation of the tomographic picture are therefore necessary. The addition of one or more shift directions is sometimes useful. In lung tomography, the apex and the postoperative narrowed chest are well adapted to examination by this method. Here the simple tomographic apparatus operating with a rectilinear shift may be used for more accurate analysis of finer details.

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SUMMARIO IN INTERLINGUA

Le Uso de Diverse Modos de Transito del Tubo in Tomographia del Pulmon

Le sequente factores contribue al occultation incomplete de umbras in le tomographia pulmonal:

1. Le distantia inter le objecto que projice le umbra e le plano del section. Augmentos del distantia resulta in occultation plus complete.

2. Le receptivitate pro radios X in le objecto. Un umbra plus dense es plus difficile a occultar.

3. Le distantia coperite per le transito de tubo e pellicula. Un transito prolongate resulta in un occultation meliorate.

4. Le direction del axe longitudinal del objecto que produce le umbra a occultar. Quando iste axe es parallel al transito del tubo, le occultation del umbra es difficilissime e frequentemente impossibile.

Le quarte de iste factores es le plus facile a regular. Isto es effectuate per alterar le

position del paciente, per exemplo ab le position craniocaudal al position oblique. Le technica del examine es describe e duo regulas principal es sublineate: (1) Le incidentia del radio central debe esser le mesme in omne tomogrammas. Isto es facile a effectuar per marcar le puncto de incidentia super le pelle del paciente. (b)

Le expansion respiratori del pulmon debe esser le mesme in omne tomogrammas. Isto es effectuate per un mechanismo que registra le grado de expansion e assi rende possibile su repetition pro omne le expositiones individual.

Es presentate tres casos como illustrationes del advantages del methodo.



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Splenic Artery Aneurysms

Report of 17 Cases Showing Calcification on Plain Roentgenograms¹

GORDON J. CULVER, M.D., and HERBERT S. PIRSON, M.D.

SINCE THE FIRST description of splenic artery aneurysm by Beaussier in 1770, only 213 cases have been reported in the literature, so far as we can determine. Winkler, in 1903, was the first to identify splenic artery aneurysms in a living person, and Hoegler, in 1920, made the first pre-operative diagnosis. The first diagnosis to be based on roentgen examination alone was made by Lindboe in 1932. In 1950, Evans obtained the first translumbar aortogram demonstrating a splenic artery aneurysm.

Owens and Coffey in a review of the literature in 1953 found reports of 198 cases of splenic artery aneurysm, to which they added 6 further examples. Since then, 9 additional instances have been recorded.

Of the total of 213 cases in the literature, only 19 were diagnosed roentgenographically or clinically prior to operation. In 11 of the 19, the condition was recognized by the presence of a calcified ring shadow on abdominal roentgenograms, and in 3 of these confirmation was obtained by lumbar aortography. In 1 instance, the diagnosis was made by aortography alone. In the remaining cases, the presence of a pulsating or non-pulsating mass or bruit in the left upper quadrant suggested the diagnosis.

In a total of 96,741 autopsy reports collected by Owens and Coffey from various articles, only 37 splenic artery aneurysms were mentioned, an incidence of 0.038 per cent. While aneurysms in general are more common in the male than in the female (a ratio of 5 to 1), aneurysms of the splenic artery occur more frequently in the female (ratio of 2 to 1).

Among 186 cases, Owens and Coffey found the average age to be forty-eight

years, with a range from fourteen to eighty-eight years. Forty-six per cent of the females were in the childbearing age, and of these 53 per cent were pregnant at the time the aneurysm was identified.

While the exact cause of aneurysm of the splenic artery is not known, several factors appear to be important. Arteriosclerotic changes in the splenic artery have been found more often than any other pathologic condition. Frequently, the arteriosclerosis involves the splenic artery only, and no other vessel. The artery is tortuous, and the arteriosclerotic changes are most prominent on the convexities of the bends. It is at these sites that aneurysms usually develop. Endocarditis and embolization of the splenic artery may in some instances be responsible for splenic artery aneurysms. Congenital defects in the internal elastic membrane of the intima or congenital fibrotic areas in the media of the artery have also been suggested as possible causes. Unlike aortic aneurysms, aneurysm of the splenic artery is seldom attributable to syphilis. In a few cases it has been ascribed to trauma and infection. In 20 per cent of Owens and Coffey's collected series, portal hypertension was found.

Although 24 per cent of the women with splenic artery aneurysms were pregnant, pregnancy is probably not a factor in the formation of aneurysms but does play a role in precipitating rupture of an existing aneurysm.

Rupture occurred in 46 per cent of the 204 cases reviewed by Owens and Coffey. It may take place into the greater or lesser sacs, the retroperitoneal space, the stomach, the colon, or the pancreas. Splenomegaly has been observed in almost half of the reported cases.

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SYMPTOMS AND SIGNS

Pain in the epigastrium or left upper quadrant is the most common complaint before rupture of the aneurysm. Various gastrointestinal symptoms are also of frequent occurrence. Physical examination may reveal some tenderness in the upper abdomen. The spleen may or may not be palpable. Occasionally a mass other than the spleen may be felt. Rarely this will show a palpable pulsation or a bruit.

ROENTGENOGRAPHY

The diagnosis of a splenic artery aneurysm can be made roentgenographically when calcium is present in its walls. This appears as an oval or round radioopaque density in the left upper quadrant. Usually, a continuous or broken ring of calcification is evident, with more irregular deposits in the center. Sometimes calcium can be seen in the splenic artery running to the aneurysm.

In an upper gastrointestinal series, a calcified splenic artery is observed to lie posterior, posteromedial or posterolateral to the pars media of the stomach. On rare occasions, pulsations may be seen against the posterior gastric wall. A barium enema shows the calcification lying above the splenic flexure of the colon. On intravenous or retrograde pyelograms, the calcification appears above the upper pole of the left kidney.

Calcifications in the left upper quadrant due to other causes must be considered in the differential diagnosis. Calcified aneurysm of the left renal artery will usually produce a defect in the renal pelvis observable on pyelography, while, as stated before, a calcified cyst of the splenic artery usually lies above the upper pole of the left kidney. Calcified echinococcus cyst of the mesentery, left lobe of the liver, or spleen must also be differentiated from splenic artery aneurysms. Such cysts are frequently multiple in the abdomen and may be found elsewhere, as in the lung. Also to be considered in the differential diagnosis, according to Seids and Hauser,

are other calcified cysts of the spleen, calcification in the cortex of a tuberculous kidney, perisplenitis, calcified tuberculous lymph nodes, calcification in the walls of renal cysts, calcified blood clot, enteroliths, and calcification in neoplasms.

In the series of 204 cases reviewed by Owens and Coffey, the mortality rate was 46 per cent; for the 124 patients with symptoms ascribable to the aneurysms, the mortality was 76 per cent.

We have collected 17 cases of splenic artery aneurysm found on x-ray examination at The Buffalo General Hospital. Six of these came to surgery and the diagnosis was proved pathologically. In the remainder the diagnosis was made on a radiological basis only. The operative cases will be presented in some detail, while only certain aspects of the others will be considered.

CASE REPORTS

CASE I: A. K., a 49-year-old white female, was admitted with a history of intermittent mild distress in the left upper quadrant, having its onset six months earlier. Except that the spleen could be palpated one finger breadth below the right costal margin, the findings on physical examination were normal.

A complete gastrointestinal series disclosed only a small ring of calcification lying posterior to the stomach, above the splenic flexure of the colon, and to the left of the kidney, measuring 1.5 cm. in diameter. *Diagnosis:* Calcified splenic artery aneurysm.

At surgery, the spleen was found to be about two and one-half to three times normal size. It was removed along with an aneurysm of the splenic artery, about one-inch proximal to the hilus. Relief of symptoms followed.

CASE II: M. N., a 61-year-old white female, stated that seven years before admission a gastrointestinal series had revealed an enlarged spleen containing "calcium disks." About ten months before admission she had experienced an attack of pain in the upper chest, radiating up through the neck. Following an automobile accident four months later, there had been intermittent pain in the upper abdomen, with radiation to the back. Physical examination was negative, except that the tip of the spleen was palpable and seemed to be slightly enlarged.

Radiographs, including an aortogram, revealed multiple calcified splenic artery aneurysms. Several of these measured 3 cm. in diameter, while others were smaller (Fig. 1).

At operation, the spleen was found to be twice its normal size, with evidence of perisplenitis in the form of vascular adhesions. The splenic artery contained multiple pulsating, partly calcified aneurysms, the largest of which was just beyond the origin of the artery from the celiac axis, impacted in the upper margin of the body of the pancreas. Splenectomy was performed, with excision of the tail and body of the pancreas and the aneurysms.



Fig. 1. Case II. Upper gastrointestinal film showing multiple calcified splenic artery aneurysms and their relationship to the stomach.

No particular change in symptomatology followed surgery. This case was recently reported by Riemenschneider.

CASE III: M. C., a 49-year-old white female, complained of aching pain in the left side, running down into the groin and through to the back. Physical examination was completely negative. Retrograde pyelograms obtained in the course of the diagnostic study showed a circular area of calcification in the left upper quadrant, measuring 3 cm. in diameter (Fig. 2). A lateral view localized this calcification anterior to the spine, indicating that it lay outside the kidney or pancreas. It was, however, too far medial to be within the spleen. *Diagnosis:* Splenic artery aneurysm.

At surgery, the spleen was not enlarged; an aneurysm, described as "the size of a golf ball," was found in the splenic artery. Splenectomy, with removal of the aneurysm, was performed, but the pain was not relieved.

CASE IV: A. Z., a 58-year-old white female, was seen with a history of vague discomfort and a feeling of lightness in the right abdomen. Physical examination was completely negative. Oral cholecystography showed a normally functioning gallbladder without stones, but revealed a calcified ring shadow,



Fig. 2. Case III. Retrograde pyelogram showing a calcified splenic artery aneurysm and its relationship to the left kidney.

measuring 3×4 cm. in diameter, in the left upper quadrant, with some calcification of the splenic artery proximal to the calcification (Fig. 3). *Diagnosis:* Calcified splenic artery aneurysm.

At operation the spleen appeared to be normal. A plum-sized calcified aneurysm was found in the region of the junction of the body and tail of the pancreas. The splenic artery was seen to pass to and away from the mass. A ligation of the artery and splenectomy were carried out.

CASE V: E. R., a 79-year-old white female, was admitted with a history of fatigue and a weight loss of 12 pounds in the past year. Her appetite was good; bowel movements were regular until four months before admission, when constipation occurred, with passage of stool every three days. Abdominal examination revealed a thrill in the epigastrium just to the left of the mid-line. A bruit was audible in this area. Radiographs of the upper abdomen disclosed an oval, laminated calcium deposit, 2.0×2.5 cm., lateral to the stomach and above the splenic flexure of the colon (Fig. 4).

At surgery, the splenic artery was found to be in intimate contact with a calcified mass; the artery was ligated and the spleen and aneurysm were removed.

CASE VI: F. F., a 58-year-old white female, complained of vague, indefinite abdominal pain and indigestion. An upper gastrointestinal series disclosed three ring-like calcifications in the left upper quadrant, localized in the region of the hilus of the

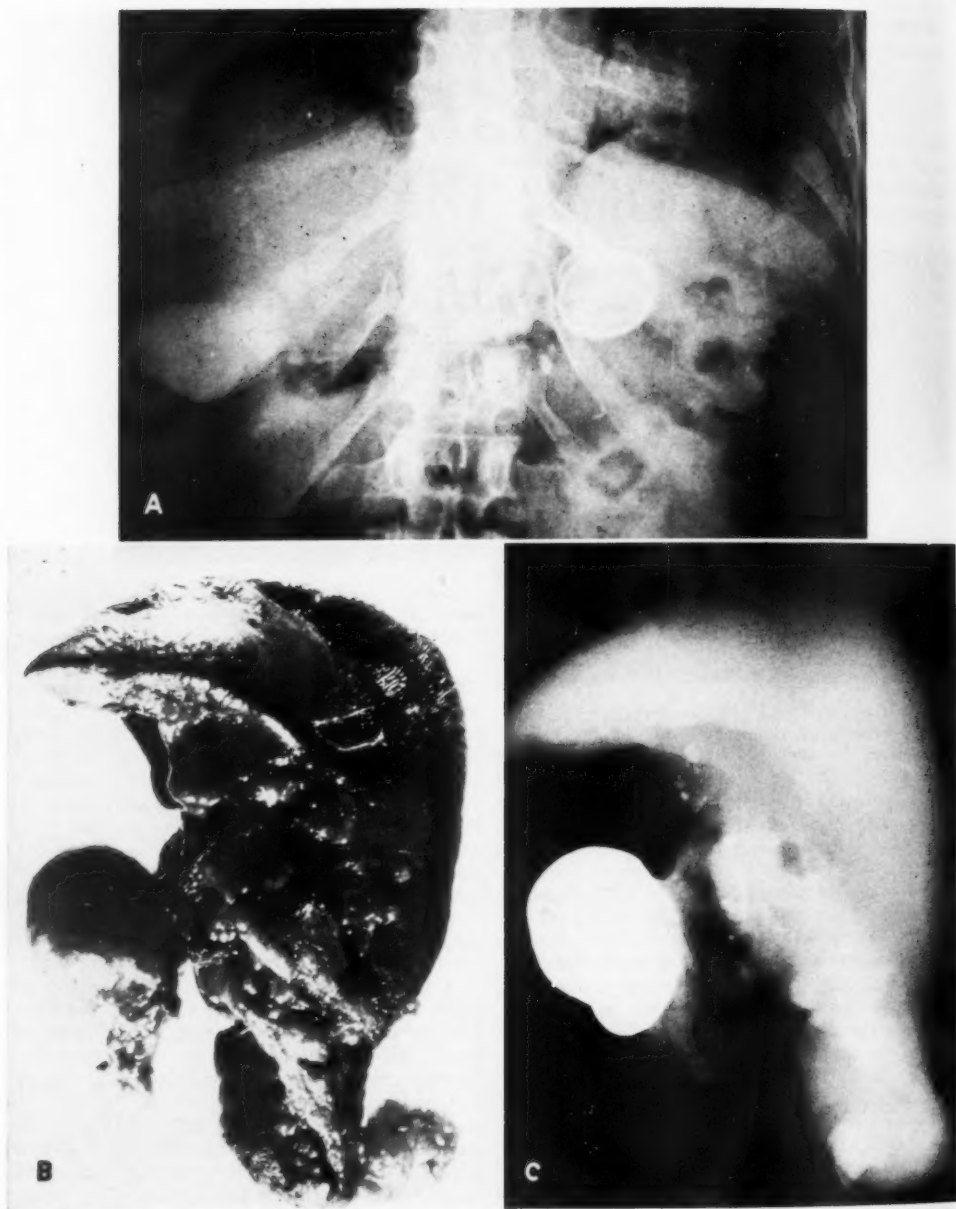


Fig. 3. Case IV. A. Calcified splenic artery aneurysm discovered incidentally on an oral cholecystogram. B and C. Photograph and roentgenogram of the aneurysm and the spleen.

spleen. These varied from 6 mm. to almost 2 cm. in diameter and were considered to represent splenic artery aneurysms.

All 6 of the cases reported above were

in females, ranging in age from forty-nine to seventy-nine, the average being fifty-nine. Four had single aneurysms, and 2 multiple aneurysms. The average diameter of the aneurysms was 2.2 cm. Five

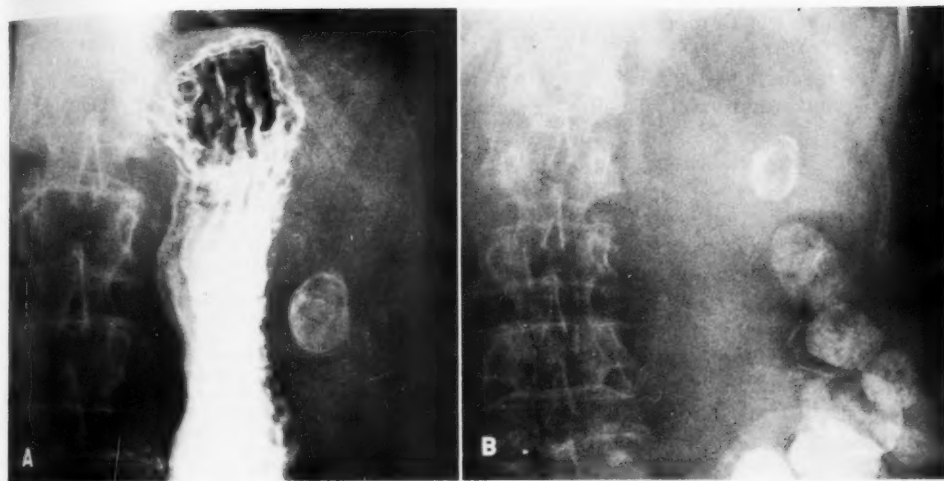


Fig. 4. Case V. A. Upper gastrointestinal film showing a calcified splenic artery aneurysm and its relationship to the stomach.
B. Film taken twenty-four hours later, showing the relationship of the calcified splenic artery aneurysm to the splenic flexure of the colon.

of the patients experienced some type of abdominal pain and 3 had gastrointestinal symptoms. In 2 cases, symptoms were relieved following surgery. In no instance was abdominal tenderness or a palpable mass encountered, but in 2 there was splenic enlargement, and in 1 a palpable thrill and audible bruit in the left upper quadrant. One patient, on roentgen examination, showed calcification in the splenic artery running to the aneurysm, but in 5 calcification was evident only in the aneurysm itself. All of the pathologic specimens showed arteriosclerotic changes in the aneurysms.

Of the 11 patients in whom the diagnosis of splenic artery aneurysm was made radiologically but not proved pathologically, 9 were females; the youngest was thirty-five and the oldest eighty-seven, the average being sixty-seven years. In 2 of the patients there were two calcified aneurysms, and in the other 9, only one. The average aneurysmal diameter in this group was 1.8 cm. Six patients experienced some type of abdominal pain, and 6 presented gastrointestinal symptoms. Three had abdominal tenderness; none showed an enlarged spleen or other pal-

pable abdominal mass. In 3 cases there was evidence of calcification in the splenic artery itself, while in the 8 remaining patients calcification was apparent in the aneurysms only.

DISCUSSION

Judging from the number of calcified splenic artery aneurysms we have encountered on radiographic examination of the abdomen, it appears that the condition is not as rare as the literature would indicate. We consider the roentgen appearance to be characteristic and believe that the diagnosis can be established on the basis of the type and location of the calcification. This appears as a ring-like shadow in the left upper quadrant, with more irregular deposits of calcium at the center. There may be calcification, also, in the course of the splenic artery. Both a gastrointestinal series and pyelograms will show the ring calcification to lie posterior, posteromedial, or posterolateral to the stomach, above the splenic flexure of the colon and the upper pole of the left kidney. The shadow usually measures between 1 and 3 cm. across. In the majority of cases, only a single aneurysm is

seen, although two or more have sometimes been demonstrated.

The average age in our series for patients with calcified aneurysm was fifty-nine in the surgically proved cases and sixty-seven in those in whom the diagnosis was made on a radiological basis only. Only 1 of our patients was in the child-bearing age. In Owens and Coffey's review of 198 cases the average age was forty-eight years, apparently indicating that the aneurysms may be present for ten to twenty years before there is sufficient calcium to be demonstrable radiographically. Thus, although rupture of a splenic artery aneurysm frequently occurs during pregnancy, the chance of making the diagnosis by demonstration of ring-like calcification in the left upper quadrant is probably slight in persons in this earlier age group.

SUMMARY

The literature on splenic artery aneurysm has been briefly reviewed. The clinical picture and radiographic appearance have been discussed, and reports of 6 proved cases showing ring-like calcification on radiographs are presented. Statistics based on 11 other cases, in which the diagnosis of calcified splenic artery aneurysm was made radiographically, are given.

SUMMARY IN INTERLINGUA

Aneurysmas del Arteria Splenic: Reporto de 17 Casos con Calcification Visibile in Roentgenogrammas Simple

Le autores presenta un revista del litteratura concernite con aneurysmas del arteria splenic e analysa le constatactiones radiologic e clinic in 17 casos de lor proprie experientia. Sex del casos es summarisate brevemente. In illos un intervention chirurgic esseva effectuate, e le diagnose esseva confirmate pathologicamente. In le remanente 11 casos, le diagnose se basava super le characteristic observationes radiologic.

Si tosto que calcification ha occurrite in le aneurysma, le roentgenogramma, secundo le autores, exhibi aspectos characteristic.

Alora le diagnose pote esser establite super le base del typo e del sito del calcification que appare in le quadrante sinistro-superior como umbra anular con depositos minus regular de calcium al centro. Calcification occurre etiam in le curso del arteria splenic. Un serie gastrointestinal e etiam pyelogrammas demonstra que le calcification anular es locate in un sito posterior, posteromedial, e posterolateral al stomacho, supra le flexura splenic del colon e le polo superior del ren sinistre.

In le majoritate del casos on vide non plus que un sol aneurysma, sed il occurre

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Roentgenologic Aspects of Retropleural Hematomas Following Sympathectomy¹

SAUL SCHEFF, M.D., WALLACE W. BEDNARZ, CAPT., USAF (MC), and GEORGE LEVENE, M.D.

IN THE PAST TEN years there have been two reports in the literature describing extrapleural effusions following operations on the sympathetic nerves of the neck and trunk (1, 2). Because of the increasing frequency of such surgical procedures, a review of the roentgen appearance and significance of these extrapleural collections appeared not to be amiss.

When a roentgenogram reveals the site of a resected rib or metallic clips in the region of a paravertebral mass associated with a history of recent sympathetic nerve resection, the origin of the mass is apparent. When the site of rib resection or the clips are not visualized, the density must be distinguished from lesions due to more serious intra- and extrapulmonary disease (Figs. 2 and 3).

ANATOMICAL FACTORS

For proper exposure of the sympathetic chain, the parietal pleura and intercostal fascia must be separated. This is usually done by finger dissection. The tissues which surround the sympathetic chain abound in intricate venous plexuses which drain the vertebral bodies and transverse processes, and communicating channels ultimately anastomose with the large intercostal veins. Many of these are torn during exposure of the sympathetic chain. Moreover, the sympathetic nerve is accompanied by a small vein, which is also severed when the nerve is cut. While the cut end of the nerve retracts, the vein still remains at the site of severance and oozing continues. Careful ligation of all bleeding points and aspiration of the retropleural space prior to closure do not preclude postoperative capillary oozing, with consequent formation of a hematoma between the parietal pleura anteriorly and the in-

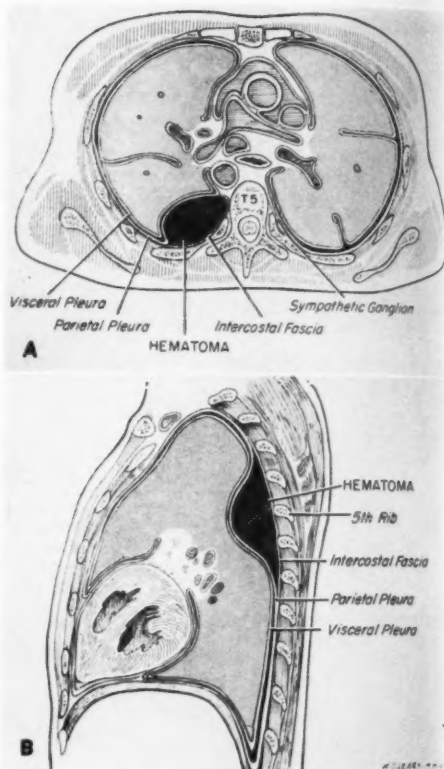


Fig. 1. A. Semidiagrammatic transverse section through a retropleural hematoma.

B. Sagittal section through the same area. The hematoma is confined between the parietal pleura in front and the internal intercostal fascia in back. These structures are moderately adherent to one another and the hematoma must dissect its path as it increases in size.

ternal intercostal fascia posteriorly (see Fig. 1).

MATERIAL

Our material consisted of 300 patients who had a total of 590 operations on the sympathetic nervous system, all of which were performed by Dr. Reginald H. Smithwick and his staff, in the great majority of

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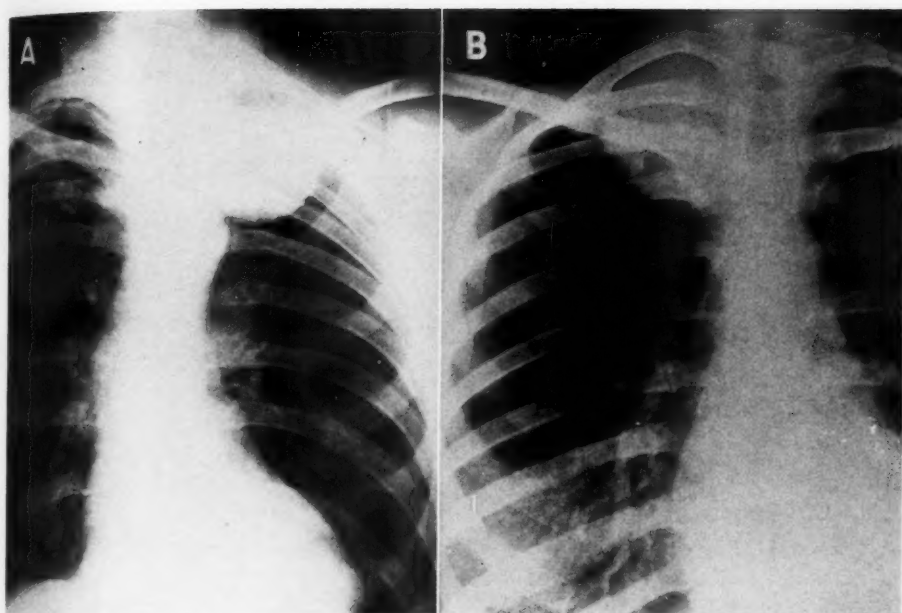


Fig. 2. A. Small retropleural hematoma three days following upper dorsal sympathectomy for intractable neuritis. Note the convex lateral and inferior borders and blending of the shadow of the hematoma with the shadow of the mediastinal structures.

B. Perineural fibroma, showing a striking similarity to the hematoma shown in A. Thinning of the posterior portion of the right first rib is a distinguishing diagnostic sign in B.

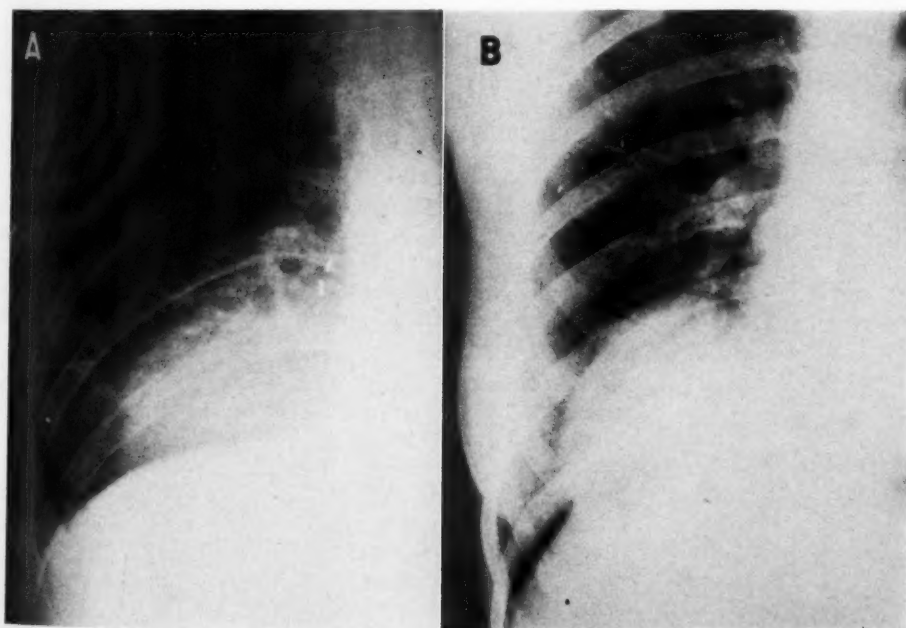


Fig. 3. A. Retropleural hematoma six days after dorsolumbar sympathectomy for essential hypertension.

B. Pericardiocelomic cyst. Note that the right cardiac border is obscured in B but not in A.

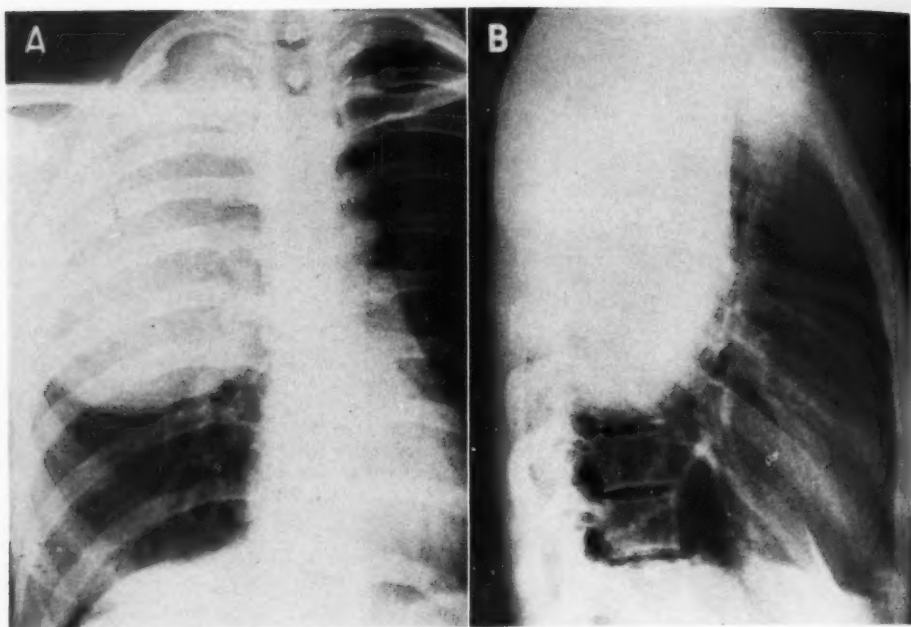


Fig. 4. A. Large retropleural hematoma one day after dorsal sympathectomy. Note resection of the second rib on either side and the presence of metallic clips. The medial border of the hematoma blends with the mediastinal shadow, and the inferior border is convex.

B. The posterior border of the hematoma is shaped by the posterior thoracic wall. The inferior and anterior borders are convex.

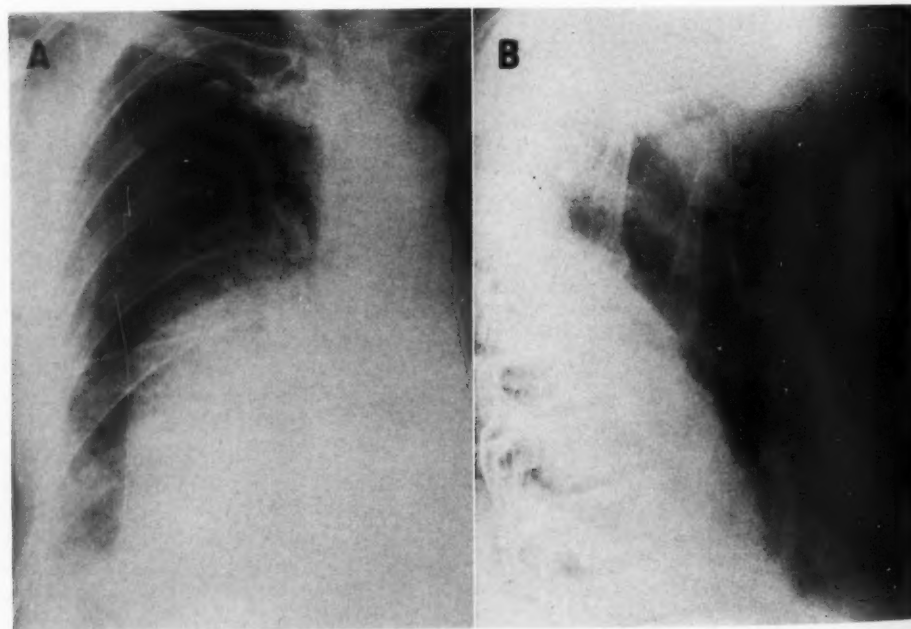


Fig. 5. A. Large retropleural hematoma eight days after dorsolumbar sympathectomy. The visualized borders of the hematoma are convex. (The clarity of the right heart border seen on the original film is not well reproduced.) There is a small amount of fluid in the short septum and pleural cavity.

B. The convex anterior and straight posterior borders are well shown. Absence of visible surgical defects may be misleading. The lung in contact with the lower portion of the hematoma is compressed.

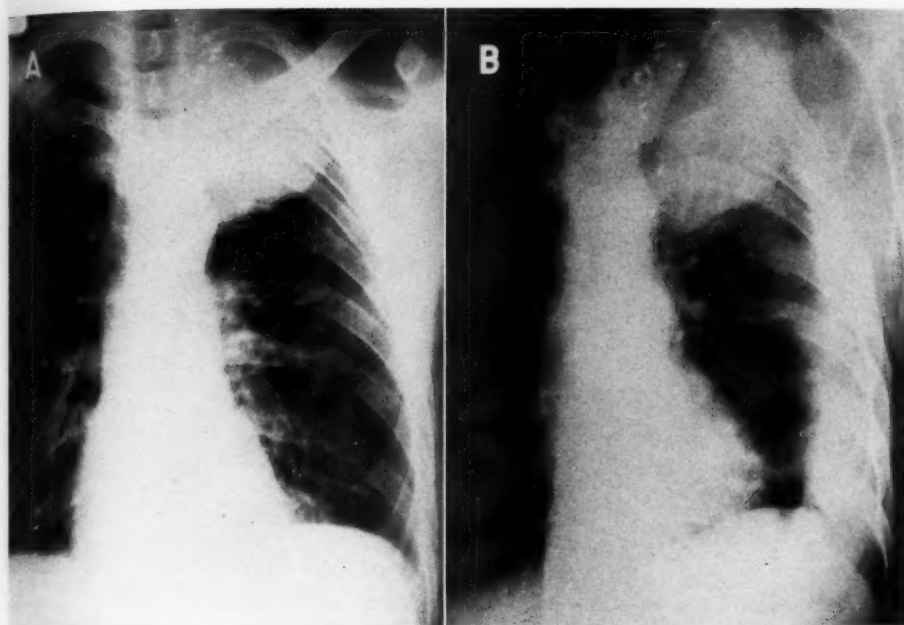


Fig. 6. A. Retropleural hematoma three days after cervicodorsal sympathectomy. The apparent high left diaphragm was thought to represent a diaphragmatic effusion.

B. Film in left lateral decubitus position, showing a shift of the fluid to the dependent left lateral thoracic wall. The contour of the hematoma remains unchanged. The density extending cephalad from the hematoma represents subcutaneous hemorrhage.

cases for relief of essential hypertension (3, 4). Most of the patients had two operations, usually separated by an interval of nine to twelve days. Recently, bilateral dorsolumbar sympathectomy has been carried out in one stage. Six operations involved the lower cervical or lower cervical-upper dorsal nerves; 31 involved the thoracic chain alone; and in the remaining 553 the dorsolumbar chain was resected.

Of 220 patients studied roentgenologically in the immediate postoperative period, 40 (18 per cent) had retropleural hematomas. Four (10 per cent) of this group were tapped. Many of the patients with clinical evidence of hematoma were asymptomatic and x-ray study was not deemed necessary. The average interval from operation to the first chest film was four and one-half days, although hematomas could be visualized as early as twenty-four hours following sympathectomy.

ROENTGEN APPEARANCE

Roentgenologically a retropleural hematoma appears as a smooth-bordered or slightly lobulated, homogeneous mass arising from the posterior thoracic wall. On a postero-anterior film the medial border of this mass is seen to blend with the mediastinal shadow. The heart or upper mediastinal border is clearly visualized through this area of abnormal density. The lateral boundary of the hematoma is more or less convex, or it may extend from the mediastinum in a downward and lateral direction (Figs. 1A, 4A, 5A, 8A). If the inferior border can be visualized, it is almost invariably convex (Figs. 2A, 4, 6).

In the lateral view, the posterior border of the area of abnormal density is almost straight, due to the unyielding tissues of the posterior thoracic wall, while anteriorly there is a fairly convex border (Figs. 1B, 4B, 5B, 8B). When the hematoma is sufficiently large, it may bulge into the

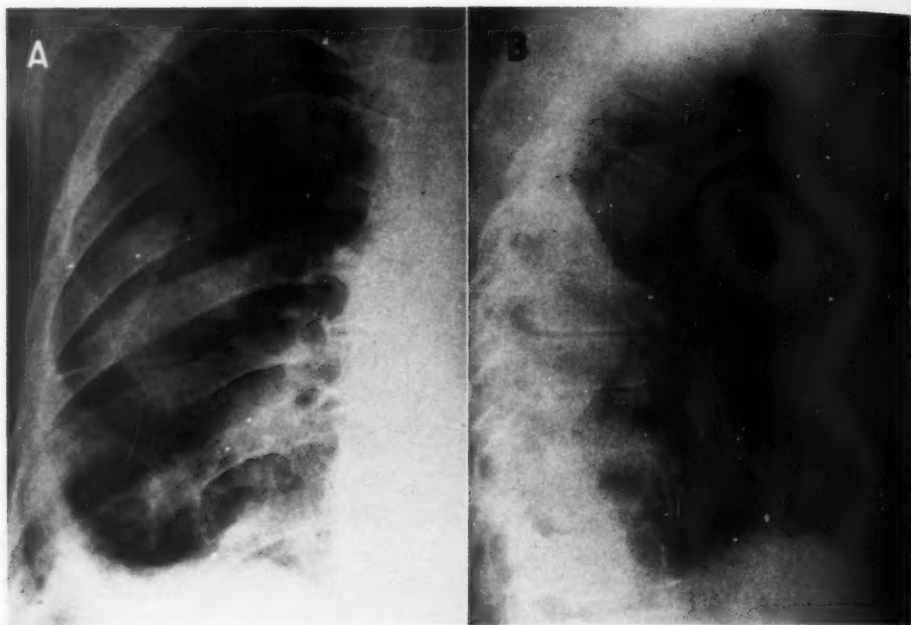


Fig. 7. Fluid encapsulated in the posterior pleural cavity fifteen days after the onset of lobar pneumonia.

A. The fluid density is seen in the lateral portion of the chest, with an intervening clear space between it and the mediastinal shadow. There is residual pneumonic infiltration in the right lower lobe.

B. The fluid is posterior but presents a double convexity of its anterior border. Retropleural hematomas show a single convexity in the lateral view. (Compare with Figs. 4B, 6B, 7B.) No dural clips or rib resections are seen.

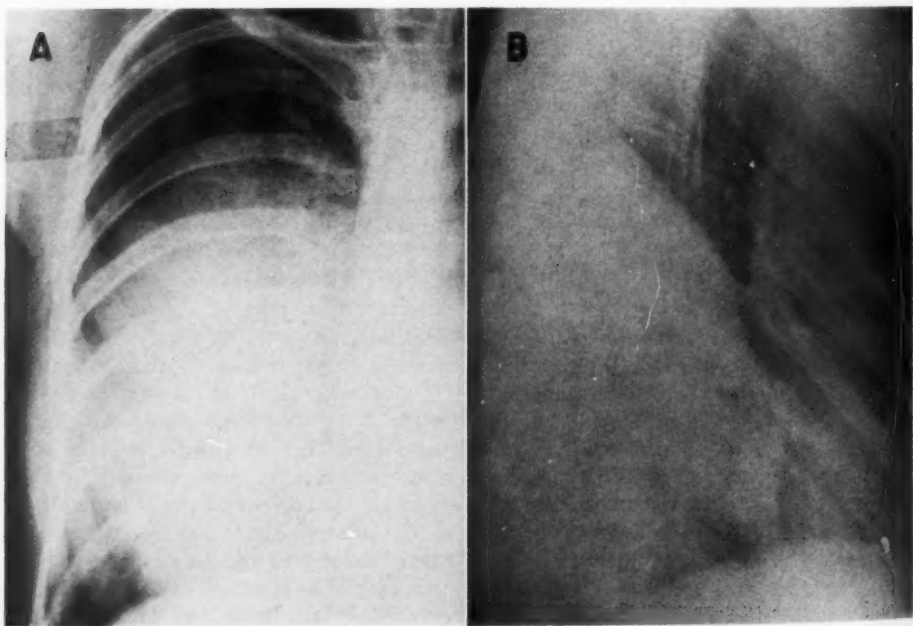


Fig. 8. Large retropleural hematoma six days following dorsolumbar sympathectomy. Note the convex superior, lateral, and anterior margins.

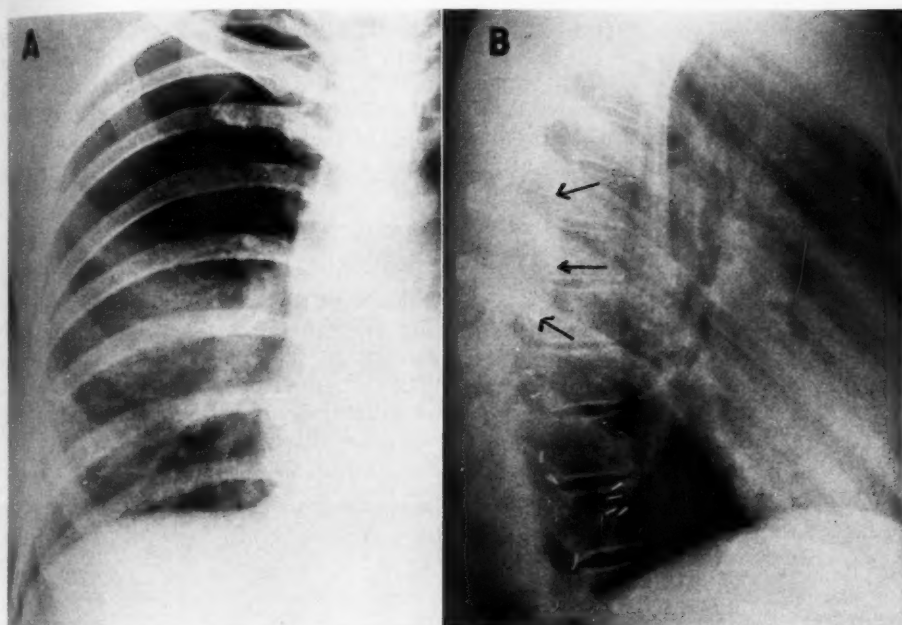


Fig. 9. Residual evidence of retropleural hematoma in case shown in Fig. 8, two years after operation.
 A. Hazy granulation and reticulation in the right mid lung field. The appearance may be mistaken for an acute infection or neoplasm. The visualized dural clips offer a suggestion as to the correct diagnosis.
 B. The anterior margin of the hematoma bed retains its convexity. There is also thickening of the overlying pleura.

thorax and compress the subjacent lung (Fig. 5B). A retropleural effusion may simulate a diaphragmatic hernia. In contrast to pleural effusions, retropleural hematomas are not affected by changes in the position of the patient (Fig. 6).

Fluid encapsulated in the posterior thorax presents a perplexing problem in differential diagnosis. If, on a postero-anterior film, the area of density is separated from the mediastinal shadow by an intervening clear space, differentiation is relatively simple (Fig. 7). In cases of paravertebral or mediastinal effusions the problem is more difficult. In general, however, it will be found that pleural effusions change in contour and distribution with a change in position of the patient; and, as in all problems of roentgenologic diagnosis, it is necessary to invoke the aid of the patient's history, the physical findings, and reports of laboratory studies.

As resorption of the hematoma occurs, the previously smooth borders become irregular and ill-defined. The time of clearing of the abnormal density is usually proportionate to the size of the hematoma. Most of them will leave no roentgenologic evidence in four months. As the mass diminishes in size and density, the bed of the hematoma assumes a reticulated appearance which may persist for two years or more (Fig. 9). This residual granularity, more common with the larger hematomas, is a result of fibrosis in the hematoma bed and, to a lesser degree, to thickening of the overlying pleura. It is important to stress the persistence of these shadows for, long after sympathectomy, they may lead to an incorrect diagnosis of pneumonia or perhaps tumor. Evidence of rib resection or metallic clips in the suspected area should create enough doubt to initiate a thorough investigation (Fig. 9A). Frequently, a lateral view will

assist in establishing the correct diagnosis (Fig. 9B).

CLINICAL FINDINGS

The smaller hematomas may produce some local discomfort and a transient rise in temperature up to 100° F. (oral). The larger collections imply greater blood loss and may produce dyspnea. Infection in the hematoma, a rare occurrence in this series, produces the usual constitutional signs and symptoms of sepsis. Surgical intervention is seldom indicated and is resorted to only for continued blood loss or for sepsis.

DISCUSSION

Retropleural hematomas will occur in spite of the most skillful surgical technic. As pointed out above, this sequel appeared in 18 per cent of the cases which we studied roentgenologically.

Retropleural hematomas are relatively innocuous. They are important chiefly because they may be confused with more serious intrathoracic lesions. A hematoma high in the cervicodorsal area may resemble a neurofibroma (Fig. 2A and B). In the mid and lower thoracic regions the appearance may simulate a number of mediastinal or

pulmonary lesions. Months after operation, the reticular pattern of an incompletely absorbed hematoma may offer diagnostic difficulties. The history, presence of metallic clips, rib resection, and a lateral view may help to resolve the problem.

SUMMARY

The roentgenologic appearance and incidence of retropleural hematomas following operations on the sympathetic nerve trunks in 590 operations are described. The benign nature of the lesion, its course, residual appearance, and differential diagnosis are discussed.

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SUMMARIO IN INTERLINGUA

Aspectos Roentgenologic de Hematomas Retropleural Post Sympathectomia

In despecto de experite technica chirurgic, hematoma retropleural pote occurrer post sympathectomia. Illo esseva observate per le autor in 18 pro cento del sympathectomizzate patientes studiate roentgenographicamente a un periodo immediate-mente postoperatori. Tal hematomas es relativamente innocue, e lor signification principal es le possibilitate de lor confusion con plus serie lesiones intrathoracic.

In le roentgenogramma, le hematoma retropleural se manifesta como un massa homogenee con margines lisie o levemente lobulate que extrude ab le pariete posterothoracic. In le vista lateral, le margine

posterior es quasi recte in consequentia del resistente tessutos del pariete posterothoracic. In le vista anterior, le margine es relativamente convexe. Le contorno se distingue ab illo de effusiones pleural in tanto que illo non cambia con un cambiamento del position del patiente. Quando le hematoma se resolve, su base pote exhibir un apparentia reticulate, e isto pote resultar in difficultates diagnostic.

Factores de importantia in le diagnose differential es signos de resection costal e le demonstration de crampas metallic in le roentgenogramma, le historia del patiente, e le supra-describite vista lateral.

A Large Carcinoma of the Adrenal

Report of a Case¹

W. C. STRITTMATTER, M.D., C. H. BROWN, M.D., and H. A. TRETBAR, M.D.

CARCINOMA OF the adrenal is a rare neoplasm, difficult to diagnose preoperatively. The few reports in the literature attest to the rarity of the tumor, while the absence of localizing symptoms in the non-hormone-producing growths explains the difficulty of early diagnosis. We are reporting one case because of the unusual radiographic features, the great size of the tumor, and the occurrence of bone formation within it.



Fig. 1. Plain film of abdomen showing large calcified mass in left upper quadrant.

CASE REPORT

A 54-year-old white man was first seen at Cleveland Clinic on Jan. 3, 1956, complaining of abdominal pain and occasional left flank pain, weakness, and a weight loss of 15 pounds. In November 1955, he was hospitalized elsewhere and a retrograde pyelogram was made. Following this there had been a considerable increase in flank pain.

On physical examination the patient appeared rather poorly nourished. Temperature, pulse, and blood pressure were normal. A large tender mass, which moved with respiration, was palpated in the left upper quadrant of the abdomen, extending to below the left costal margin. A chest film was negative, but a plain abdominal film revealed in the left upper quadrant a large, irregular area of calcifica-



Fig. 2. Lateral film of abdomen showing calcified mass.

tion approximately 12 cm. in diameter. A urogram, obtained after administration of 20 c.c. of Hypaque, indicated normal renal function. The right kidney appeared to be normal but the left kidney was depressed and distorted by the large calcified mass, which was believed to be an adrenal tumor.

The patient was hospitalized on Jan. 5, 1956. A urinalysis was normal except for a trace of albumin and a few red cells per high-power field. A complete blood study showed a hemoglobin content of 13.2 gm. per 100 ml. and a white cell count of 17,500 per cu. mm.

On Jan. 6, an upper gastrointestinal radiographic series was reported as showing "intrinsically normal esophagus, stomach and duodenum, with displacement of the stomach by a calcified mass, probably an adrenal tumor." A diagnosis of probable left adrenal tumor was made, and the patient was operated upon the next day by E. F. Poutasse, M.D., of the Department of Urology. A large mass, approximately $23 \times 12 \times 8$ cm., was found to be in continuity with the left kidney and was removed fol-

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Fig. 3. Intravenous urogram showing downward displacement of left renal pelvis by the mass, which appears to be extrinsic to the kidney.

lowing ligation of the renal pedicle. The regional nodes were free, and collateral exploration of the abdomen yielded no evidence of metastasis. The postoperative course was uneventful.

Pathological Report: The mass in continuity with the left kidney weighed 1,750 gm. Grossly, the outer surface was covered by hemorrhagic exudate; it was nodular, and varied in consistency from soft to stony hard; it contained two large areas that grossly resembled cortical and cancellous bone. The tumor was encapsulated throughout except at the lower pole, adjacent to the kidney, where there was a slightly soft area of kidney measuring $12 \times 4 \times 5$ cm. The kidney capsule was stripped easily from the tumor and revealed a smooth, brown, subcapsular surface. Microscopically there was capsular invasion and gross venous extension. Focal chronic pyelonephritis was found in the left kidney. The final diagnosis was adrenocortical carcinoma.

DISCUSSION

Adrenal carcinoma occurs usually in persons beyond the age of thirty, showing no sex predilection (1). Malaise is a common presenting symptom, as is abdominal-flank pain. A mass is often palpable. Metastases in the lungs, lymph nodes, liver, and occasionally in bones, may be evident before the primary tumor can be

identified. Calcification is frequently seen in the adrenals secondary to healed tuberculosis; rarely it may occur secondary to foreign bodies, former hemorrhages or thrombi, or dead parasites (2). Sympathicoblastomas and carcinomas commonly contain calcification, but bone for-



Fig. 4. Anterior displacement of barium-filled stomach by tumor mass.

mation within adrenal tumors is extremely rare. In our patient the great size of the tumor excluded consideration of infection as a cause of the calcification, which, furthermore, radiographically resembled that seen in bone tumor.

Boice and Sears (3) described the largest adrenal carcinoma heretofore reported in the literature; it weighed approximately 1,500 gm. and contained dystrophic calcification secondary to necrosis within the tumor mass. The tumor mass we are reporting weighed 1,750 gm. and contained areas of cancellous bone formation. Occasionally calcification will occur in the wall of a cyst of the adrenal cortex, producing a mass in the region of the adrenal (4).

The diagnosis of adrenal tumor some-

times can be made from a plain film of the abdomen. A urogram and occasionally a laminagram will be of diagnostic aid, especially if the tumor is not calcified. In many instances retroperitoneal air insufflation will accurately define the lesion. It may be difficult to distinguish an adrenal tumor from a primary renal neoplasm, although one would expect an adrenal tumor to displace the kidney without causing significant distortion of the pelvicalyceal system.

SUMMARY

A large adrenal carcinoma showing unusual radiographic findings is reported. The presenting complaints were malaise and abdominal-flank pain. Radiographs demonstrated a large, calcified adrenal

mass that displaced the left kidney downward. No metastases were found at operation nor have they been demonstrated since. The neoplasm was excised and the postoperative course was uneventful.

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SUMMARIO IN INTERLINGUA

Un Grande Carcinoma del Adrenal: Reporto de Un Caso

Carcinoma del corpore adrenal es infrequente, e su diagnose preoperatori es rar. Le autores presenta un caso con inusual aspectos radiographic. Le patiente se plangeva de malaise e dolores del fianco sinistre. Un massa sensibile poteva esser palpate in le quadrante sinistro-superior del abdomine. In le roentgenogramma iste massa se revelava como un grande area irregular de calcification. Le ren sinistre

esessa displaciate in basso. Le diagnose tentative de tumor adrenal esessa confirmate al operation.

Le dimensiones del massa esessa circa 23 per 12 per 8 cm. Su peso esessa 1,750 kg. Illo contineva duo grande areas grossieramente simile a osso cortical e cancellose. Nulle metastases esessa constatate. Le excision del tumor esessa sequite per le restablimento del patiente sin incidentes.



The Roentgen Diagnosis of *Armillifer* Infection (*Porocephalosis*) in Man¹

HOWARD L. STEINBACH, M.D., and HERBERT G. JOHNSTONE, Ph.D.

HUMAN INFECTION with the nymphs of a species of *Armillifer* (*Porocephalus*) is uncommon except in West Africa, where it has been found in 7.8 per cent of the autopsies performed by Seiffert and in 8 per cent of those performed by Lohlein, as quoted by Cannon (1). Only two instances of parasitism in man by these degenerate worm-like arthropods have been reported in the United States (2).

An infection by a species of *Armillifer* was recently encountered at the University of California Hospital, San Francisco. This case is being reported here because the roentgen appearance is pathognomonic and is the only practical means of establishing the diagnosis short of laparotomy and biopsy. Four other articles dealing with the roentgen appearance of this disease have been published (3-6).

J. O., a 55-year-old Filipino, was referred to the University of California Hospital by Dr. Emanuel Stolman with a provisional diagnosis of an infection by a species of *Armillifer*, based upon the roentgen examination by Dr. William Cress. The patient complained of malaise, weakness, and chest and back pain of two months duration. He had a cough, productive of a small amount of yellow sputum, and dyspnea on exertion. He gave a recent history of chills and fever.

Physical examination and extensive laboratory tests failed to reveal any significant abnormalities.

Roentgen examination showed numerous small calcific densities scattered throughout the chest and abdomen. These measured approximately 3 to 6 mm. in length, although most were less than 4 mm. The shape of these calcific shadows varied from semicircular to rectilinear, with the majority presenting intermediate forms. Stereoscopically, it was demonstrated that several of the calcified lesions were in the region of the pleura and peritoneum, whereas others appeared to be within the pulmonary parenchyma and intra-abdominal viscera. Some could be seen bilaterally both in the inguinal regions and in the scrotum (Figs. 2-4). Roentgenograms of the skull and extremities revealed no evidence of disease. A gastrointestinal series, barium enema

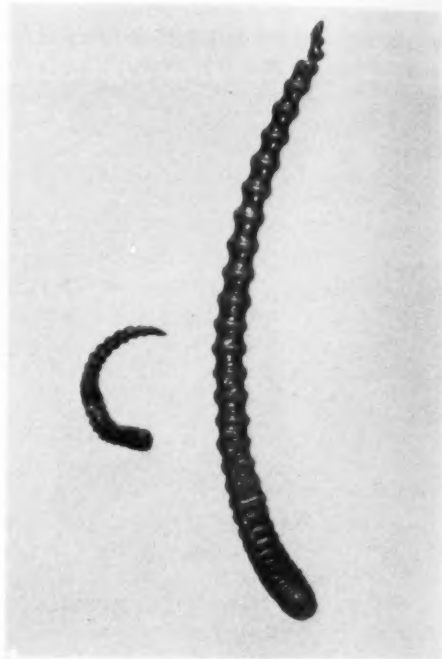


Fig. 1. Adult male (smaller) and female linguatulidæ.
×1.4.

study, oral cholangiogram, cholecystogram, and intravenous urogram were all normal.

The final clinical impression was an infection by a species of *Armillifer*. It was believed that the infection was not the cause of the patient's symptoms.

DISCUSSION

The species of *Armillifer* which are parasitic in man and other animals belong to the family Linguatulidæ ("tongue worms"), a group of degenerate worm-like, blood-sucking arthropods which are endoparasites of vertebrates. They are not closely related to any other arthropod group and their classification with the *Arachnida* (by some investigators) is questionable. The adults are elongated, mark-

¹ From the Departments of Radiology and Parasitology, University of California School of Medicine, San Francisco, Calif. Accepted for publication in August 1956.

edly annulated, and without any trace of legs, antennae, or palpi (Fig. 1). The mouth, surrounded by a chitinous ring, is situated at the anterior end of the "worm." There is a pair of retractile hooks on either side of the mouth. The sexes are distinct. In all species the male is much smaller than

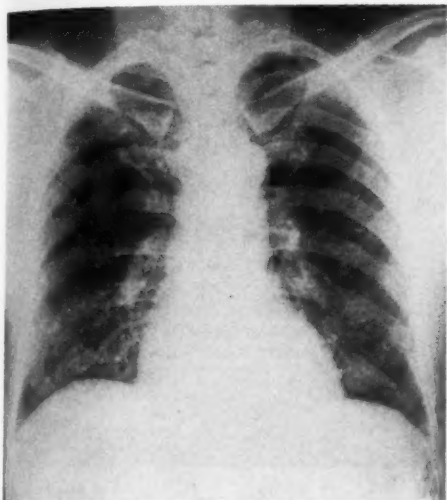


Fig. 2. Rectilinear and semilunar calcific shadows in the pleura and pulmonary parenchyma bilaterally.

the female. The Linguatulidae lay eggs which are enclosed in a thin, bladder-like structure containing fluid. Within the thick shell of the egg is a developed embryo having rudimentary mouth-parts and either four or six rudimentary legs. The encysted larval stage (nymph), which occurs in another host, is structurally almost identical with the adult form, varying considerably in size according to the stage of development. The larvae are usually found closely coiled into a more or less complete circle, the ventral surface usually forming the convexity.

In an excellent classification of the Linguatulidae, published in 1922, Sambon (7) listed 13 genera and 43 species. He stated that five of the species are known to be possible parasites of man: *Porocephalus crotali*, *Porocephalus subulifier*, *Armillifer armillatus*, *Armillifer moniliformis*, and *Linguatula serrata*. Of these, *Armillifer*



Fig. 3. Calcified nymphs in the scrotum. There are no calcifications in the muscles, which helps in differentiating this disease from *Cysticercus cellulosae*.

armillatus has been most frequently encountered. The adult is found living in the trachea and lungs of pythons and other African snakes; the nymphal form is found in the lion, mandrill, giraffe, and African hedgehog, as well as in other wild and domestic animals in tropical Africa. It is this particular species which has been the subject of articles describing the radiographic aspects of the disease (3, 4, 6). A few cases have been reported from the Orient in which *Armillifer moniliformis* was the parasite involved. The adult form of this species is parasitic in snakes in India, Malaya, and the East Indies; the nymphal stage has been found in various monkeys, the civet, the tiger, the Indian otter, and the domestic dog. The adult form of *Porocephalus crotali* is parasitic in New World rattlesnakes; the nymph is parasitic in various small mammals. Two cases of human infection possibly by this species have been reported from the United States (2). *Linguatula serrata* is primarily a parasite of dogs and other carnivores. Human infection by the adult parasite is rare, but infection by the larva is not uncommon.

In the genus *Armillifer*, the adult fe-

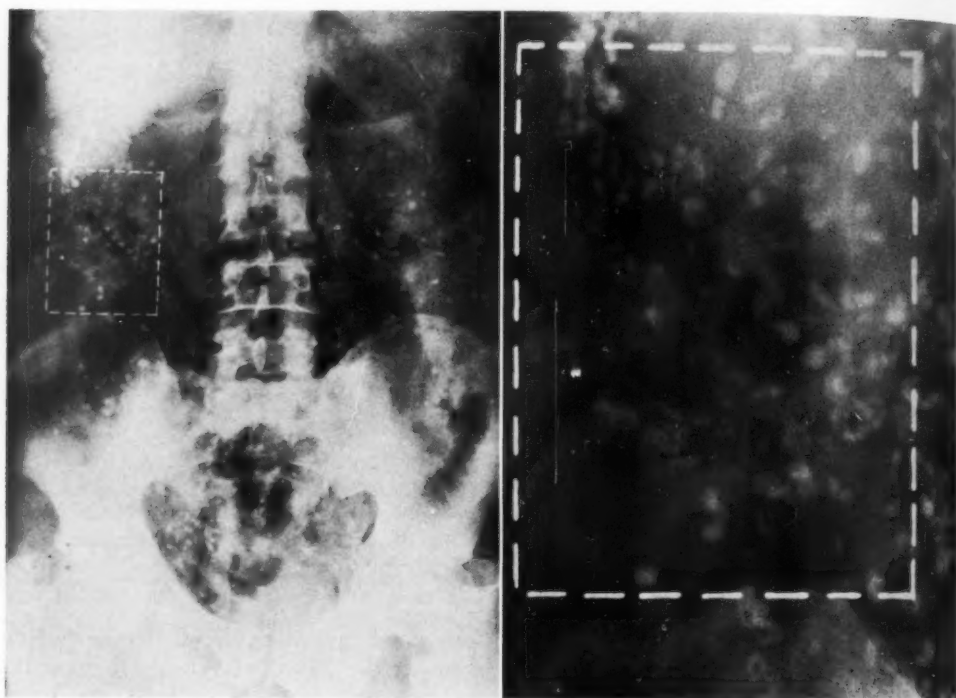


Fig. 4. A. Numerous calcified nymphs are present in the peritoneum and the abdominal viscera. B. Enlargement showing the characteristic shape of the calcified nymphs.

male, parasitic in the trachea and lungs of various snakes, lays eggs which are passed with the bronchial secretions or with the excreta of the snakes. Food and water contaminated by these eggs are ingested by various wild and domestic animals and occasionally by man. In the intestine of these intermediate hosts, the four-legged larvae are liberated from the egg and penetrate to the liver, lungs, mesenteric nodes, kidneys, and other organs. During development, the larva moults several times and is finally encysted as a nymph. When the animal which serves as the intermediate host is eaten by a snake, the nymphs are liberated and enter the lungs of the definitive host, where they develop into adult forms.

The only known method of infection of man by a species of *Armillifer* is through the ingestion of the eggs of the adult parasite which have been passed in the bronchial secretions or the excreta of snakes.

It has been the supposition that the parasite has been found mainly in natives who belong to tribes that eat raw snakes. It seems more probable, however, that infection would be acquired following the ingestion of food or water contaminated with the sputum or excreta of snakes. Van den Berghe (8), in producing experimental infections in animals, demonstrated that the eggs showed considerable resistance in water. He also noted that the bladder-like structure surrounding the egg was digested not in the gastric juice but in the duodenal juice.

It is not possible to determine how the infection was acquired in the case reported above nor is it possible to determine what particular species of linguatulid was involved. The patient, a native of the Philippine Islands, stated that there were numerous large snakes in the area around his home. In view of what has been said previously regarding modes of infection,

it is possible that the patient ingested drinking water or raw vegetables containing eggs of the parasite. The numerous calcific shadows observed in the roentgenograms in all probability represented the dead calcified nymphs of *Armillifer moniliformis*, since this is the species found in various regions of the Orient. In the only previous report from the Philippines of a case of human infection by *Armillifer moniliformis*, nymphs were found in the liver of a native of these islands (9).

In most reported cases the infection was thought to be of no clinical significance. In an excellent review of the subject, Cannon (1) included a case of intestinal obstruction and cited other cases in which pneumonitis, peritonitis, meningitis, pericarditis, nephritis, and obstructive jaundice due to bile duct obstruction have been ascribed to infection by linguatulids. In the present case it is thought that the disease had long been quiescent and was not responsible for the symptoms described by the patient.

The demonstration of the nymphs on roentgenograms depends upon their death and calcification. The calcific shadow is characteristic in appearance and distribution. It is from 3 to 6 mm. in length and varies in shape from semilunar to rectilinear, depending upon the plane in which the nymph lies. Rectilinear shadows cannot be differentiated from those due to *Cysticercus cellulosae*, but if semilunar shapes are present among the usually numerous calcified lesions, the diagnosis can be made. The distribution of the calcified nymphs also serves to differentiate densities caused by these parasites from those due to other parasites. The lesions

have been seen only within the thoracic and peritoneal cavities, with the exception of the present case, in which calcified nymphs were present also within the scrotum. Many of the nymphs are located in the peritoneum and pleura, while others are present in the lungs and in the abdominal viscera. The roentgen appearance of infection with all species of linguatulidae is similar.

SUMMARY

A case of human infection with *Armillifer moniliformis* is described. Roentgenograms presented a characteristic pattern of curved and rectilinear calcific shadows located within the pleural and peritoneal cavities and within the scrotum, representing the calcified nymphs.

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SUMMARY IN INTERLINGUA

Roentgenodiagnose de Porocephalosis (Infection per Armillifer) in Humanos

Le infection de humanos per nymphas de species de *Armillifer* (= *Porocephalus*) es incommun, excepte in West-Africa. In le Statos Unite solmente 2 casos de parasitismo in humanos per iste degenerate arthropodos vermoide ha essite reportate.

Le autor presenta un tertie caso, observate in un philippino de 55 annos de etate. Le calcificate parasitos presentava un configuration characteristic, composita de umbras curvate e rectilinee intra le cavitates pleural e peritoneal e intra le scroto.

The Heterotropic Excretion of Intravenously Injected Contrast Media¹

JULIAN ARENDT, M.D., and ADAM ZGODA, M.D.

AN UNUSUAL roentgen observation, having only two antecedents in the medical literature, is here reported. A contrast medium injected intravenously to demonstrate the kidney (urography) was instead taken up by the liver, leading to intense visualization of the gallbladder and the common duct. The problem of the conditions under which such a change of direction or affinity might occur, or might be induced by a chemical structural change of the carrier substance, seemed worthy of consideration.

A 53-year-old white man with a history of dyspnea on exertion for the past two years, associated with some degree of orthopnea, contracted a cold four weeks before admission, with sneezing and coughing productive of a moderate amount of white sputum. There had been a weight loss of 5 pounds in the past month, but no hemoptysis, fever, or night sweats. Four weeks prior to admission nosebleeds had developed, occurring three times a day, lasting for various periods and always ceasing spontaneously.

The patient had been a heavy drinker for years and had suffered a *bout of jaundice* in 1915. He was a well nourished, stocky individual, in no particular distress. He had a Grade I apical systolic murmur, and auscultation revealed inspiratory and expiratory râles over both bases. There was slight pitting edema over the ankles. No masses were palpable. The temperature was 98.6°, pulse 92, respirations 24. Blood pressure was 170 systolic and 96 diastolic. Neither cyanosis nor jaundice was present.

The urinary findings were: albumin, 2 plus; pH 5.5; specific gravity 1.004. The total serum protein was 6.9 gm. per 100 ml., and the AG ratio 0.9. Results of other tests were as follows: thymol turbidity 3.1 units; serum phosphatase 0.8 Bodansky units; serum glucose 85 mg. per 100 ml.; serum urea nitrogen 31 mg. per 100 ml.; creatinine 1.3 mg. per 100 ml.; cephalin-cholesterol flocculation negative; Kahn and Kline tests negative. The red blood count was 4,630,000; white cell count 14,250.

Roentgen examination of the kidneys, after intravenous injection of 30 c.c. of Hypaque, showed no evidence of elimination at ten, twenty, and thirty-five minutes. The one-hour film revealed unexpected filling of the gallbladder, and at two hours

both the gallbladder and the common and hepatic ducts were clearly visualized (Figs. 1 and 2).

In summary, a substance regularly given for urography was excreted by way of the liver, with concentration in the gallbladder after two hours.

A search of the world literature disclosed only 2 similar cases. It is possible, however, that other such occurrences may have been missed or have gone unreported. Herskovits (2) published the case of a forty-seven-year-old man with complaints characteristic of a kidney stone. An earlier examination with Urokon B had revealed normal renal elimination, but a repeat study showed no excretion by the kidney after twenty minutes. Instead, the gallbladder was poorly visualized. The patient experienced nausea and broke out in a sweat. The author attributed this unusual occurrence to either hepatic damage or the presence of impurities in the substance of the ampule, which misdirected the medium to the liver filter.

The second case, recorded by Reinhardt (7), was that of an eighty-year-old man with a history of dysuria for two months and a tumor involving the lower bladder circumference. Seven minutes following the intravenous introduction of Diodone (per-abrodil) the gallbladder was visualized. Reinhardt advanced the theory of liver damage as the cause of the misdirection of the injected medium but found no clinical evidence of this. Our own case points rather to the target organ, the kidney, as the source of the error.

The question arises whether a similar phenomenon may not more frequently occur in Cholografin studies. Even in apparently healthy persons, immediate kidney elimination of this medium is not unusual, supposedly representing 10 per cent of recirculated and diluted Cholografin

¹ From the Department of Radiology, Mount Sinai Hospital, Chicago, Ill. Accepted for publication in June 1956.

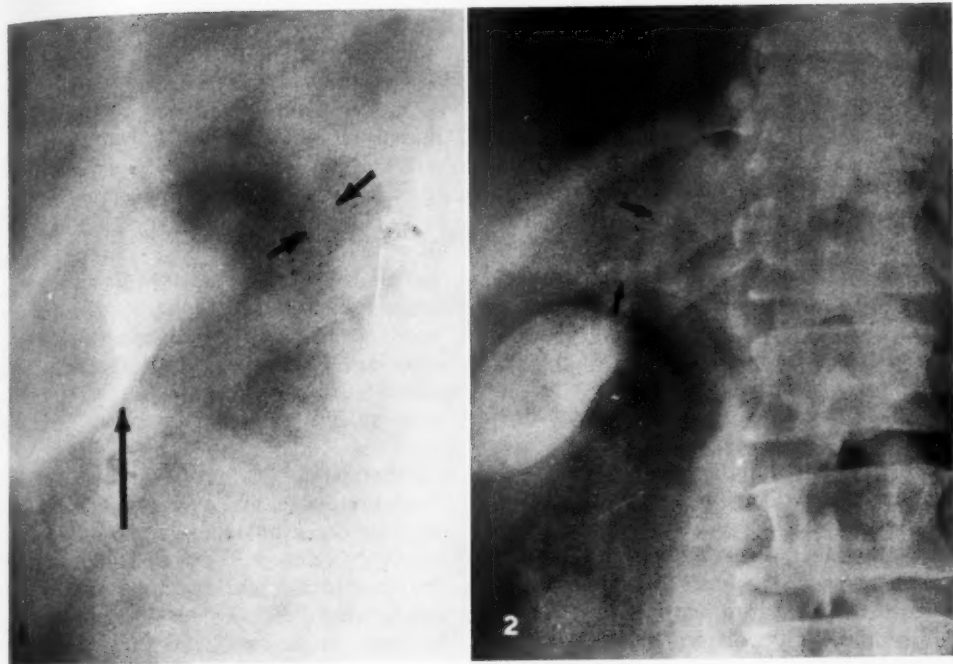


Fig. 1. One-hour film showing unexpected filling of the gallbladder and common duct after injection of 30 c.c. of Sodium Hypaque.

Fig. 2. Two-hour film in which the gallbladder and common duct, as well as the hepatic duct, are clearly visualized.

which reaches the kidney, while the remaining 90 per cent is excreted through the liver. This proportionate distribution is not a fixed one, as recently pointed out by Frommhold and Oeser (1, 4, 5), since the urinary excretion rises considerably in the presence of disturbances in the hepatobiliary system (Fig. 3).

The phenomenon of "heterotropic excretion" could, therefore, be explained very simply, as due to a pathologic condition of the target organ interfering with proper elimination of the medium. It could, on the other hand, represent an inundation process due to introduction of too much of the material in too short a time, permitting partial deviation and excretion through an alternative route. Neither of these explanations is fully satisfactory, since neither accounts for the rare occurrence of the



Fig. 3. Thirty-minute film revealing concentration of Cholografin in the common duct and in the renal pelvis.

reversal and the rapidity of the deflection.

The difference between a pyelographic and cholegraphic medium lies essentially in the nature of the carrier. It is the carrier which controls the pathway, holding the iodine molecule firmly bound and being itself chemically inert. The historical development of contrast media was based on the known property of such a substance as urea to serve as a clearance test for the kidney, and of phenolphthalein to be passed almost completely by the liver. Yet it is significant that the first pyridine compound was originally intended for sterilization of a gallbladder infection, and only incidentally proved to be the best medium then available for excretory urography. A similar unpredictability was observed by Oeser and Frommhold for ^{131}I -labeled Biliselectan (Cholografin), which showed a urinary excretion rate of 28 to 82 per cent within twenty-four hours under physiologic conditions. In a comprehensive investigation of the excretion by the liver and kidney of various dyes, Matsuo and Yano reached the conclusion that the theory of Ehrlich and Moellendorf, namely, that materials usually excreted by the liver are of higher colloidal structure and those excreted by the kidney lower in colloids and of greater diffusibility, is over-simplified. Among factors to be taken into consideration is the choice of test animal. In dogs the excretory function of the liver in relation to a given substance is high as compared with rabbits, in which the same material may be completely eliminated by the kidneys. The excretion of the true dyes, therefore, is unforeseeable and best determined by experiment.

A high degree of selectivity for the liver has been demonstrated for the iodopiamide compound known as Cholografin. This medium has proved of great clinical value, but is still slightly marginal. Its percentage of excretion by the liver, fixed at 9:1 under normal conditions, is probably modified not only by liver disease, but also by neurovascular reflexes originating in

the kidney or liver. The regulation of such losses might be subject to pharmacological influence. The concept of an intravenously injected contrast medium as a guided missile, carrying its iodine charge to a selected organ, is correct only if we allow for a large degree of variation and deflection under pathological conditions, not all of which are obvious. With recognition of the hepatorenal syndrome, neurovascular shunts and hepatotropic reflexes have been found to occur (3). These vascular shunts may well represent the missing link in the explanation of the 3 cases of heterotropic excretion reviewed here.

Other examples of this phenomenon include the occasional excretion of per-abrodil into the stomach, explained as being possibly due to salivary gland action, and the observation by Rigler and Mixer (8) of kidney visualization after cholangiography, resulting from excessive pressure in the presence of a common duct obstruction.

SUMMARY

An unusual observation of the elimination of an intravenously injected urographic medium (Hypaque) not by the kidney but by the common duct and gallbladder is reported. Two similar cases, recorded in the foreign literature, are reviewed. The principles and implications of these instances of the heterotropic excretion of contrast media are considered.

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SUMMARIO IN INTERLINGUA

Le Excretion Heterotrope de Substantias de Contrasto a Injection Intravenose

Le autores reporta le occurrentia inusual del elimination de un intravenosemente injicite substantia urographic (Hypaque) per le ducto commun e le vesica biliari plus tosto que per le ren. Es citate duo simile casos que esseva reportate in le litteratura extratatounitese. Le explicationes possibile de iste "excretion heterotrope" include (1) le condition pathologic del organo de mira (in iste casos le ren) que obstrue le elimination efficace del substantia e (2) un condition inundatori in que un quantitate troppo grande del substantia

se presenta in un tempore troppo breve.

Es signalate que le description de un intravenosemente injicite substantia de contrasto como un specie de "projectil guidate" que se move verso un preseligite organo del corpore es adequate solmente si on admitte le possibilitate de variationes e deflexiones in casos de conditiones pathologic. Per exemplo, le derivationes neurovascular e le reflexos hepatotrope que ha essite observate in le syndrome hepatorenal pare ben qualificate a explicar certe casos de excretion heterotrope.



Corner Positioning for Visualization of the Brachiocephalic Vessels

ISRAEL STEINBERG, M.D., and BERNARD K. RYAN, R.T.

THE TERM brachiocephalic vessels is an old anatomical designation for the innominate vein and artery. In recent years, it has become useful to designate the branches of the innominate vein as well as the arteries which arise from the aortic arch, *i.e.*, innominate, left common carotid, and left subclavian arteries. With the advent of angiocardiology, visualization of these vessels became significant (1-7). They may be demonstrated with unusual clarity, after opacification, by positioning the patient's head in a corner of the roentgen recording device. The purpose of this brief report is to illustrate the technic and results of corner positioning for visualization of the brachiocephalic vessels.

TECHNIC AND RESULTS

Corner positioning is not new, having long been used in roentgenography of the extremities and skull. It makes use of the principle that the diagonal of a square is greater than any of the sides. Placing the head of the patient in a corner of a 12 × 12-inch roll-film magazine (8) provides a field 17 inches in length, a space more than ample for the head and shoulders even of the adult (Fig. 1). Serial angiocardigrams with the patient reclining or sitting erect against a corner of the magazine provide multiple views of the brachiocephalic veins and arteries (Fig. 2).

COMMENT

The veins from the head and neck join the upper extremity veins to form the innominate veins in an inverted "T" figure (Fig. 2, A and B). Similarly, the brachiocephalic arteries emerge from the aortic arch and proceed to the arms and neck in an inverted "T" fashion (Fig. 2, C and D).



Fig. 1. Photograph showing corner position of head and neck on the 12 × 12-inch roll-film magazine.

The arrangement of these vessels is such that corner positioning of the head is ideal for their visualization. With the arms at the side, even the brachial arteries can be seen (Fig. 2C). If a roll-film magazine is used, serial angiocardiology will allow visualization of both venous and arterial brachiocephalic vessels. The use of a single cassette after the injection of a contrast medium will also provide information, albeit limited as compared to serial studies.

SUMMARY

Corner positioning of the head and shoulders on or against a 12 × 12-inch roll-film during serial angiocardiology provides an excellent field for visualization of the brachiocephalic vessels. As a result, significant information regarding these vessels in health and disease can be obtained.

¹ From the Departments of Radiology and School of Radiography, The New York Hospital-Cornell Medical Center, New York, N. Y. Aided by a grant from the Mallinckrodt Chemical Works. Accepted for publication in June 1956.

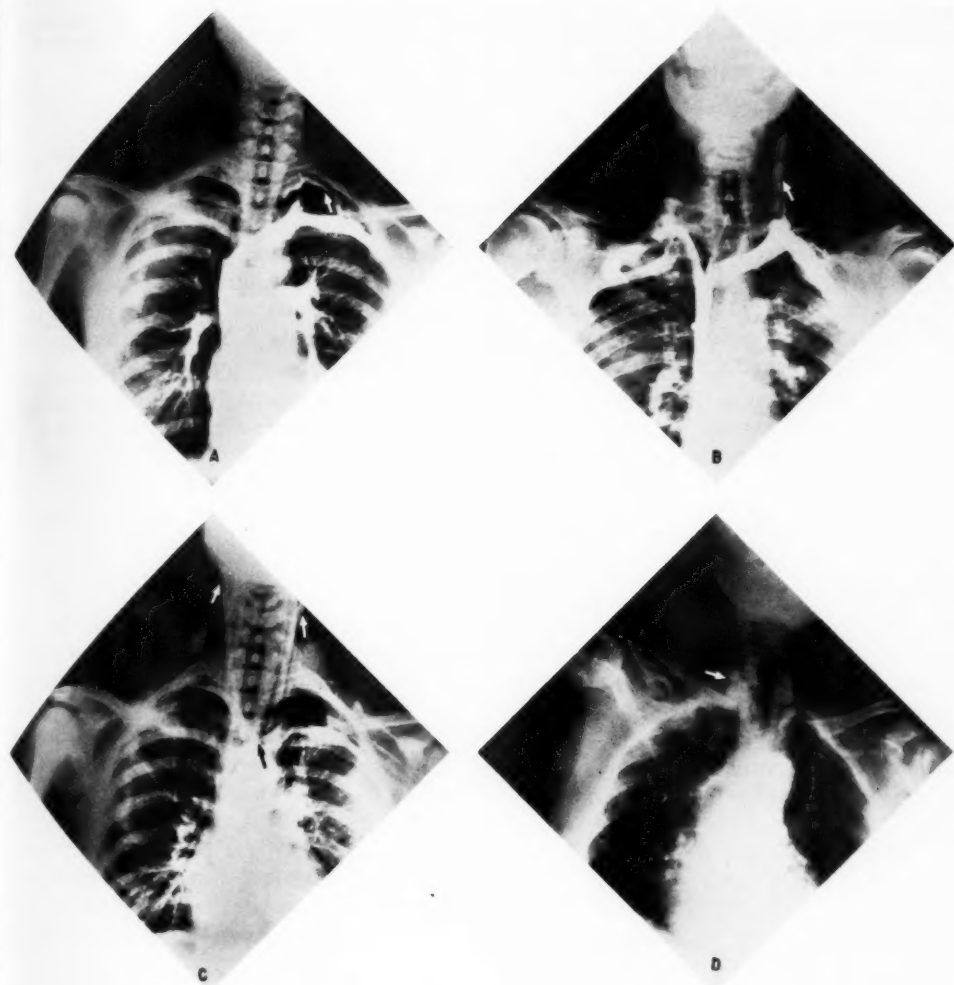


Fig. 2. Illustrations of the value of corner positioning for visualization of the brachiocephalic vessels.

A. The normal left venous route to the heart. Insignificant and normal reflux filling of a small branch of the left subclavian vein is also present (arrow). B. Pronounced reflux of contrast material into right innominate vein and neck vessels (arrows) in a 50-year-old man who had bilateral removal of the clavicles for relief of Raynaud's disease. C. Visualization of the brachiocephalic arteries in a 16-year-old girl with dysphagia lusoria. Note the origin of the right subclavian artery from the descending portion of the aortic arch (arrow). The arterial circulation of the neck (arrows) and the right subclavian, axillary and brachial (arrow) arteries are well delineated. D. Buckling of the right subclavian artery in the neck (arrow) in a 61-year-old woman with hypertension. The study ruled out the presence of an innominate artery aneurysm.

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SUMMARIO IN INTERLINGUA

Placiamento Angular pro le Visualisation de Vasos Brachiocephalic

Le placiamento del capite e del humeros super o contra le angulos de un pellicula in bobina de 12 per 12 pollices durante le obtention de angiocardiogrammas in serie provide un excellente campo pro le visu-

alisation del vasos brachiocephalic con le patiente in postura reclinate o erecte. Le methodo permette le collection de informationes significative in re ille vasos in condition normal e pathologic.



An In Vivo Method for the Determination of Cardiac Output¹

ROBERT E. MACK, M.D., HERSCHEL J. WELLS, M.D.², and ROBERT POLLACK, B.S.

THE VALIDITY of the dye dilution method for the determination of cardiac output has been confirmed by Hamilton and his coworkers (1), as well as Doyle and his group (2). Reports from several centers (3-5) indicate a similar volume of distribution for the dye, T-1824, and radioiodinated human serum albumin during the early moments following an intravenous injection. Pritchard and his associates (6) have described the use of radioiodinated human serum albumin rather than dye in the determination of cardiac output. In their method, blood from an intra-arterial needle is led past the sensitive surface of a scintillation counter, making possible a continuous graphic recording of the arterial concentration of the radioactive material. Huff and his group (7), working in this country, as well as a British group under the direction of Veall (8) have reported the use of an external counter positioned over the chest for the determination of the arterial flow curve. The present study was undertaken to determine the accuracy of the calibration technique required by such external counting methods and to assess the possible clinical applications of the procedure.

METHODS

The equipment for this study consisted of a scintillation counter with a directional lead shield, a scaler, a counting rate computer, and its recorder. The detector is positioned over the second left intercostal space adjacent to the sternum. Five to 15 microcuries of radioiodinated human serum albumin contained in a volume of 0.5 to 1.0 c.c. is injected rapidly into a brachial vein. The changes in the radioactive iodine concentration of the blood which follow are reflected on a curve inscribed by

the graphic recorder. Ten minutes later, with the position of the external counter unchanged, a venous blood sample is obtained for purposes of calibration.

In 10 patients, the cardiac output value determined by the *in vivo* counting method was compared with the value obtained simultaneously by analysis of serial arterial blood samples.

Calculation of the output value is based on the derivation as described by Veall. In brief the average flow rate is

$$F = \frac{I}{\int_0^\infty C dt} \quad (1)$$

where I is the quantity of tracer injected, C is the instantaneous concentration of the isotope in the mixing chamber, and t is time (Fig. 1).

When an external counter is placed over the chamber, the concentration $C = XN$, where N is the counting rate and X is the constant relating counter efficiency to tracer concentration. Then Equation 1 becomes

$$F = \frac{I}{X \int_0^\infty N dt} \quad (2)$$

In a system in which the external counter is placed over two chambers in series, such as the right and left sides of the heart, the curve recorded is a summation of the two separate chamber concentrations. This is shown diagrammatically in Figure 2. Since N here is a summation of N_r plus N_l , the constant X becomes

$$X_n = \frac{C}{N_r + N_l}$$

and Equation 2 becomes

$$F = \frac{I}{X_n \int_0^\infty (N_r + N_l) dt} \quad (3)$$

¹From the Radioisotope Clinic, Walter Reed Army Medical Center, Washington, D. C. Presented in abstract form at the Twenty-eighth Annual Meeting of the Central Society for Clinical Research, Chicago, Ill., Nov. 4 and 5, 1955. Accepted for publication in March 1956.

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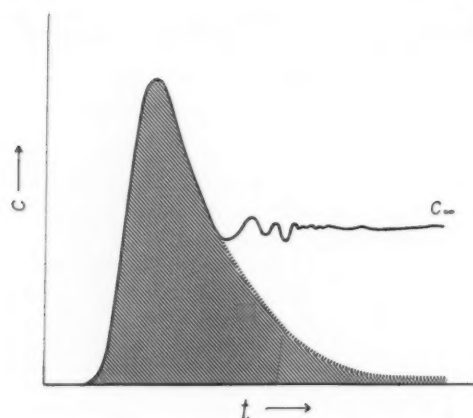


Fig. 1. Relationship of the counting rate, after mixing, to the curve of primary circulation (shaded area). Modified from Veall (8).

In practice, X is calculated from the ratio of the venous concentration of the radioactive material ten minutes after injection and the counting rate of the external counter at this time.

This same type of analysis can be shown to apply for any number of elements in series. The only requirement is that recirculation does not obscure graphic analysis of the descending limb of the curve.

The reproduction of a typical *in vivo* counter curve is presented in Figure 3. The replot of this curve with extrapolation of its descending limb after the manner of Hamilton is depicted in Figure 4. Since the factor $\int_0^\infty (N_r + N_1) dt$ is the area under the curve, Equation 3 becomes

$$F = \frac{I}{X_n A} \quad (4)$$

RESULTS

The cardiac output in 22 normal adult men was studied by the *in vivo* method. The average cardiac output for the group was 6.0 liters per minute. The average cardiac index was 3.18 liters per minute per square meter, with a standard deviation of 0.73 liter. In 10 subjects a comparison was made between this method and a simultaneously performed determination by means of serial arterial blood

TABLE I: COMPARISON OF CARDIAC INDEX DETERMINATIONS BY THE ARTERIAL AND *IN VIVO* METHODS IN TEN SUBJECTS

Subject	Arterial	In Vivo	Per Cent Difference
1	3.59	3.52	1.9
2	4.2	3.80	9.5
3	4.46	4.42	0.9
4	2.75	3.34	21.4
5	4.57	3.80	16.8
6	3.45	3.04	11.9
7	4.71	5.13	8.9
8	4.51	3.97	12.0
9	4.86	4.78	1.6
10	3.39	3.98	17.4
Mean	4.05	3.98	
Standard deviation	0.70	0.64	

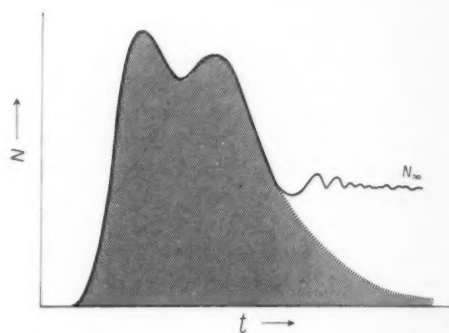


Fig. 2. Summation curve of an externally positioned counter.

samples. The data obtained in these studies are presented in Table I. A test of significance of the difference resulted in a probability value of 0.7.

DISCUSSION

The average value for the cardiac index obtained in the normal subjects is well within the range of values previously reported for the dye dilution method (2, 11, 12). No significant difference was found for the average cardiac output between the *in vivo* method and an arterial sampling technic. Pritchard and his group (13) have recently reported similar studies in 33 patients, in which the estimate of cardiac output by external counting showed an average deviation of ± 7 per cent from the arterial puncture determination. Huff (7, 14) has compared the output value cal-

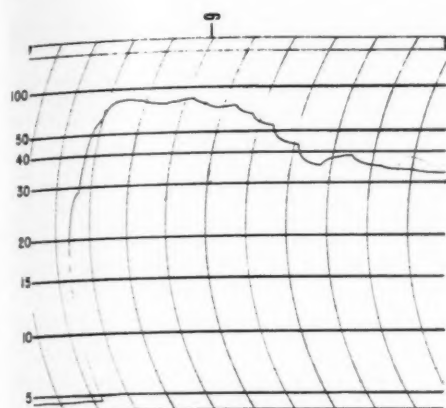


Fig. 3. Recording of the *in vivo* counter curve. Time is plotted on a linear scale along the abscissa (2.5 second intervals between time lines). Pulses are plotted on a logarithmic scale along the ordinate. During this study, the setting of the scaler was such that each pulse equaled 100 counts.

culated by the Fick method with a simultaneous estimate by the *in vivo* technic. The difference between the two methods was not statistically significant.

The position of the external counter is such that it will detect radioactivity in the ascending aorta, the left pulmonary artery, and the left atrium. The resultant curve is a composite, therefore, of the concentration of radioactive material contained in the outflow of blood from both ventricles. As would be expected, the width of the external counter curve is several seconds greater than that plotted from serial arterial samples. Mathematical justification for the analysis under these circumstances has already been presented. The contribution to the counting rate of the *in vivo* counter made by radioactive iodine in the chest wall ten minutes after injection is difficult to determine. Recent studies by Huff (14) suggest that it does not materially affect the calibration factor.

The determination can be performed with ease, even in the most excitable patient. We have found it wise to double the dose if a repeat determination is to be accomplished within a short time after the initial examination.

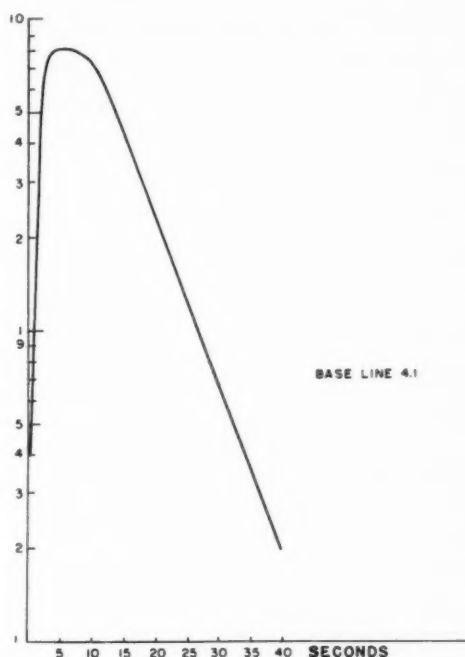


Fig. 4. Replot of Fig. 3 according to the method of Hamilton. Time is plotted on the abscissa. The units on the ordinate are pulses per minute as in Fig. 3.

SUMMARY

1. A mathematical analysis of an *in vivo* method for the determination of cardiac output, using an externally positioned scintillation counter and radioiodinated human serum albumin as the trace material, has been presented.

2. Twenty-two normal adult men were studied by this technic. The average cardiac output was 6.0 liters per minute. The average cardiac index was 3.18 liters per minute per square meter, with a standard deviation of 0.73.

3. Simultaneous studies were performed to compare the cardiac output value obtained by the *in vivo* method with that obtained by serial arterial blood sampling. No significant difference was found between the output values calculated by the two methods.

4. The technic is simple and occasions little anxiety in the patient. It is accu-

rate, reproducible, and readily adaptable to clinical studies.

ACKNOWLEDGMENT: The authors are indebted to the personnel of the Radioisotope Clinic and to the staff at Walter Reed Army Hospital, whose cooperation made this study possible.

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SUMMARY IN INTERLINGUA

Un Methodo pro le Determination in Vivo del Rendimento Cardiac

Es presentate un analyse mathematic de un methodo pro le determination in vivo del rendimento cardiac per medio de un contador de scintillation a position externe e human albumina seral marcate per iodo radioactive como traciator Vinti-duo normal masculos adulte esseva studiate per iste technica. Le valor medie del rendimento cardiac esseva 6,0 litros per minuta. Le valor medie del indice cardiac esseva 3,18 litros per minuta per metro quadrato, con un deviation standard de 0,73.

Studios simultanee esseva executate pro comparar le valores del rendimento cardiac obtenite per le presente methodo con le valores obtenite per specimens de sanguine arterial in serie. Nulle differentia significative esseva trovate inter le valores calculate secundo le un e secundo le altere de iste duo methodos.

Le technica es simple e evoca pauc anxietate in le patiente. Illo es exacte, reproducible, e facilmente adaptate a studios clinic.

Effect of Antepartum Diagnostic Roentgenography on the White Blood Cell Count of the Newborn Infant¹

IRWIN H. KAISER, M.D., Ph.D., and JAMES F. MARVIN, Ph.D.

THE EFFECT ON the white blood cell count of the newborn infant of diagnostic roentgenography of the mother late in pregnancy does not appear to have been studied. Teratologic consequences of embryonal exposure to irradiation during the first trimester are known. The fact that the fetus receives total-body irradiation in both these situations suggests that, if the dose is adequate, exposure such as that produced in x-ray pelvimetry might produce a measurable leukopenia.

The results of the present study indicate that there is no significant change in the newborn infant's white count induced by diagnostic maternal roentgenography and, further, that the radiation dose is ordinarily too small to produce such an effect.

MATERIAL AND METHODS

The white blood cell count of all normal term infants admitted to the newborn nursery of the University of Minnesota Hospitals during this study was made by routine laboratory methods. All infants admitted in the twenty-four hours prior to the five weekday mornings were studied until 125 infants had been examined. The counts on a pair of twins subsequently proved to have erythroblastosis fetalis and on a premature infant found to be sick were discarded.

Most of the counts were done in duplicate on separate pipettings of heel blood. All results checked within 10 per cent. For the summaries the first count recorded was used.

The names of the mothers were subsequently obtained from the Obstetrical Department records and cross-checked against the Radiology Department's files. All abdominal x-ray films obtained during

TABLE I. WHITE BLOOD CELL COUNTS OF NEWBORN INFANTS

	No maternal x-ray	Maternal x-ray examination
Number	101	22
Mean WBC/mm ³	19,732	19,391
Range WBC/mm ³	9,250-33,900	11,500-33,200
Standard deviation	6,470	5,920
Standard error	644	1,262

the period of obstetrical care at the University Hospitals were recorded. As a cross-check, this list was compared with Obstetrical Department pelvimetry reports. There is no reason to believe that any cases were missed.

The technician doing the white blood cell counts had no way of knowing which infants' mothers did or did not have x-ray examination.

RESULTS

The mean white blood cell count of infants born after abdominal x-ray studies of their mothers during late pregnancy was 19,391, as compared to 19,732 for the unirradiated controls. This is not a significant difference. See Table I.

Fourteen of the 22 infants were exposed to irradiation in the last fourteen days of pregnancy, 3 of these on the day of delivery. Twenty of the 22 exposures were within thirty-one days of delivery. When the white blood cell counts were ranked by the number of days from exposure to delivery, no trend could be found.

One mother had fourteen abdominal x-ray examinations within four weeks of delivery. The infant had a white blood cell count of 16,100.

The majority of the irradiated mothers had been subjected to pelvimetry by the precision parallax shift method, involving

¹ From the Department of Obstetrics and Gynecology and the Department of Radiology, University of Minnesota Medical School, Minneapolis, Minn. Accepted for publication in July 1956.

the use of pairs of anteroposterior and lateral films. When indicated, these films were repeated, so that for most patients four to eight films were obtained.

For the anteroposterior films, the factors were 74 kvp, 150 mas, 36-inch F.F.D., producing an estimated surface dosage of 3.7 r. For the lateral films the corresponding figures were 84 kvp, 300 mas, 36-inch F.F.D., 8.6 r.

The estimated depth dosage for these factors is given in Table II.

TABLE II. ESTIMATED DEPTH DOSAGE FOR THE UNIVERSITY OF MINNESOTA PELVIMETRY TECHNIC

Depth	Dose in per cent of Surface Dose	Milliroentgens	
		AP	Lateral
10 cm.	15	475	1290
15 cm.	5	170	430
17.5 cm.	3	100	260

If the depth of the fetus in the anteroposterior films is estimated as 10 cm., and in the lateral as 17.5 cm., the total dose to a given point in the fetus from the four

routine films is 1,470 mr. Assuming an average fetal weight of about 3 kg., this is a total-body dose of about 4.4 kg. roentgens. This estimate has been checked in a suitable phantom and found to be satisfactory.

This total-body dose is, of course, very much less than that associated with significant effects in laboratory animals or with teratogenesis in the early human embryo. This calculation would suggest that there is no reasonable fetal contraindication in terms of immediate effects, such as leukopenia, to diagnostic roentgenography in late pregnancy.

SUMMARY

Diagnostic maternal roentgenography in late pregnancy does not produce significant changes in the white blood cell count of the newborn infant. The estimated total-body dose to the fetus from parallax pelvimetry is 4.4 kg. roentgens.

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SUMARIO IN INTERLINGUA

Le Effecto de Roentgenographia Diagnostic Ante Parto Super le Numeration Leucocytic in le Neonate

Numerationes globular esseva executate in 125 infantes neonate, incluse 22 qui habeva essite exponite in utero a irradiation occasionate per le roentgeno-examine del matres. In 20 del 22 casos le exposition occurreva intra trenta-un dies ante le parturition, usualmente in le curso de

pelvimetria. Nulle significative differentias del numeration leucocytic esseva constatate inter iste infantes e illes con matres non subjicite a roentgeno-examines. Le dose total de irradiation que le feto recipe in pelvimetria parallaxic es estimate como amontante a 4,4 r/kg.

Disaster Monitoring with Amateur Photographic Film and with Dental X-Ray Film

MARGARETE EHRLICH, Ph.D.

IF AN ATOMIC disaster were to strike an urban community, it would be of great importance to have some means of reconstructing, at least approximately, the pattern of radiation dose distribution over the different sections of that community. Two recent publications (1, 2) from the Kodak Research Laboratories deal with the problem of radiological monitoring with amateur and commercial photographic roll films manufactured by the Eastman Kodak Company. A study of a similar nature has been carried out at the National Bureau of Standards. The total number of film types investigated was smaller than that covered in the second of the papers cited above, mainly because the investigation was restricted to types that would be widely available in any urban community. The work was not limited, however, to the products of any one film company, but covered all products generally available in drugstores, photographic stores, and dental offices throughout the United States. The data were obtained in a series of laboratory tests and in an actual field exposure to the prompt radiation from the detonation of a nuclear device during the 1955 series of atomic tests at the Nevada Test Site.

EXPOSURE IN BULK

Tests were performed to determine the feasibility of interpreting dose from films exposed in their original packages. It was found that amateur roll films could be used in the original case, provided the dose interpretation was made from the density on areas not obliterated by the image of the central metal spool, and located in the outer third of the film length. The exposure of dental films in large boxes containing 100

or more films was found to be undesirable, mainly because of the filtering action of the lead backing provided in all tested brands of dental film packets.² All work described in this paper was therefore carried out on roll films in the original packages and on single or paired dental film packets.

DENSITY-*vs.*-EXPOSURE RELATIONS

Figures 1 and 2 give the density-*vs.*-exposure relations for six types of amateur black-and-white roll film and for six types of dental x-ray film, obtained with radiation from a Co⁶⁰ gamma-radiation source. All laboratory processing (solid lines) was done in Kodak Liquid X-Ray Developer for five minutes at 68° F. This type of processing is fairly realistic for dental films, but not for amateur roll films; a spot check was therefore made of the influence of a variation in processing conditions on film response, by sending identically exposed roll films to commercial amateur laboratories for routine processing. The dashed lines in Figure 1 show the results obtained by three different laboratories whose processing techniques, though apparently closely controlled, are seen not to be identical. Such differences between the results are large enough to make processing of all film material in one laboratory imperative. If at all possible, all films should be processed simultaneously and calibration films should be included with the "unknown" samples. The choice of processing solutions will depend on the particular dose range of interest.

ENERGY DEPENDENCE

Energy dependence studies were carried out on two representative types of dental and roll-films. Narrow spectral bands of x-

¹ From the Radiation Physics Laboratory, National Bureau of Standards, Washington, D. C. This work was supported by the Federal Civil Defense Administration. Accepted for publication in July 1956.

² The response of the first and last film in a box containing 150 dental films differed by a factor of three for exposures to Co⁶⁰ gamma radiation and by a factor of the order of 5,000 for exposures to 70-kev x-radiation.

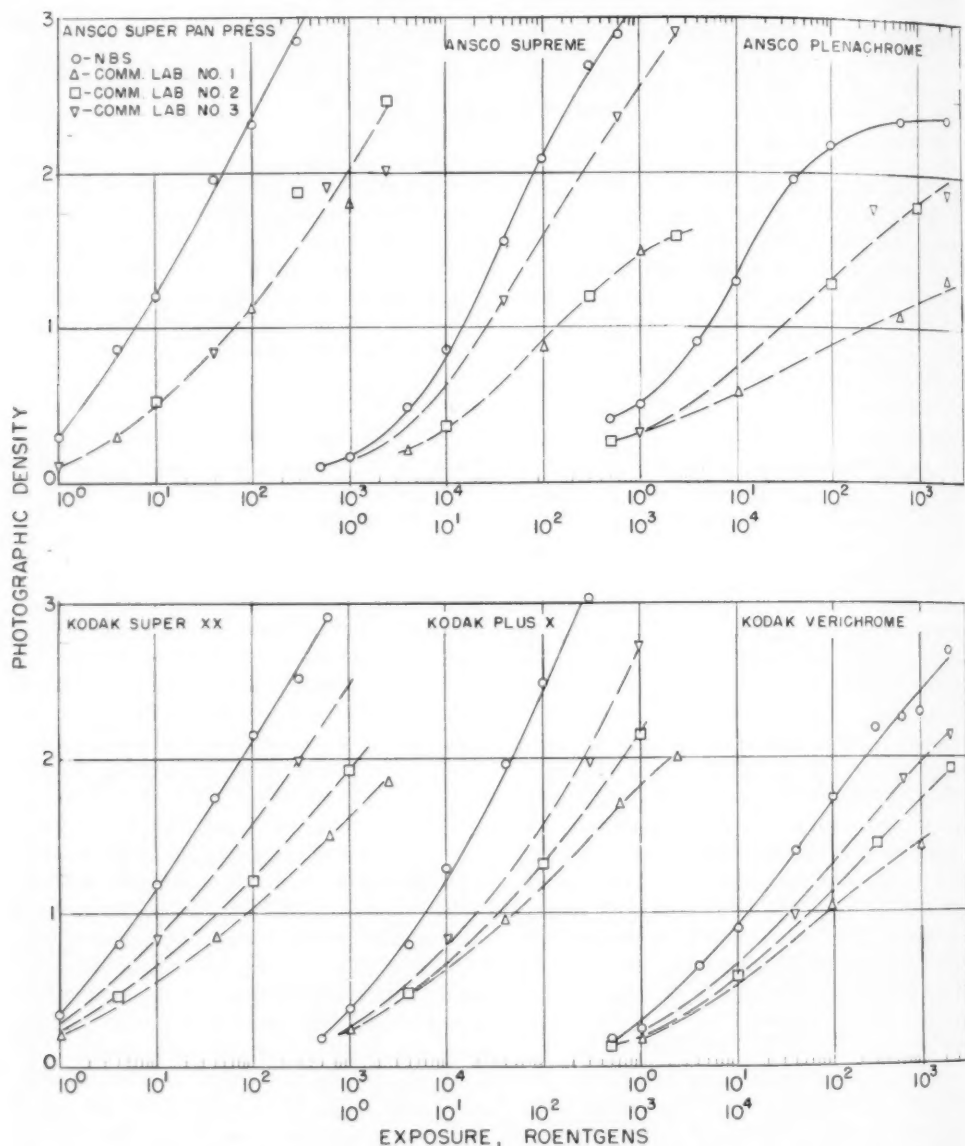


Fig. 1. Density-vs.-exposure relation for amateur black-and-white roll films exposed to Co^{60} gamma radiation.

radiation produced at four different constant potentials and radiation from a Co^{60} gamma-radiation source were used for the exposures. As the response of film material to radiation of energy above 0.3 MEV varies only slowly with energy, it was not considered necessary to obtain response data for more than one energy point

above 0.3 MEV for this order-of-magnitude study.

Figure 3 shows relative experimental sensitivity values both for the bare dental films and for the roll films, exposed to x-radiation of four different energies and to Co^{60} gamma radiation. Sensitivity is here defined as the reciprocal of the dose re-

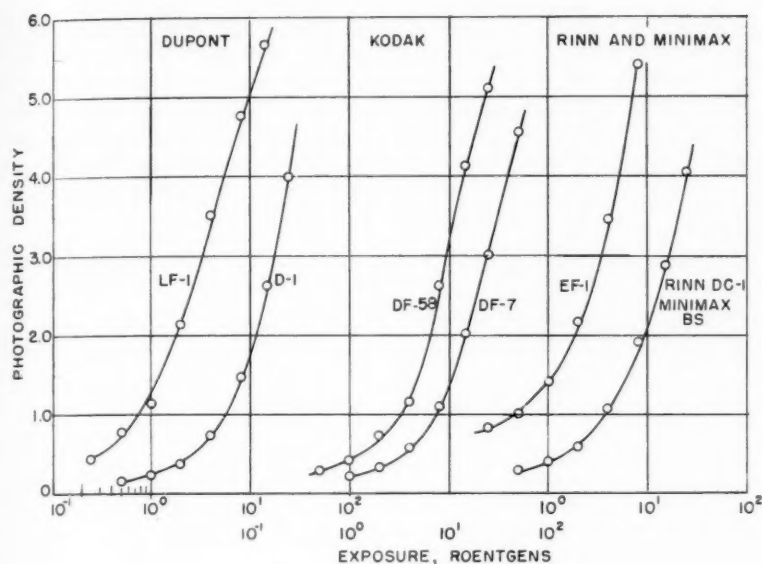


Fig. 2. Density-vs.-exposure relation for dental x-ray films exposed to Co^{60} gamma radiation (front film).

TABLE I: RESPONSE OF COMMERCIAL AMATEUR BLACK-AND-WHITE ROLL FILM TO RADIATION FROM FISSION: COMPARISON WITH READINGS OF OTHER INSTRUMENTS

Dose Interpretation (r) from Density on						Other Field Measurements (r) at Approximately the Same Locations
Planachrome	Anso Supreme	Super Pan Press	Verichrome	Kodak Super XX	Plus X	
2.5	3.2	3.0	3.4	3.6	2.9	2.5- 4.5
4.9	5.6	5.0	7.1	6.4	5.0	4.9- 9.3
9.0	14	8.0	9.2	9.4	9.4	9.4- 19
18	20	15	27	21	20	18 - 37
28	41	30	37	40	31	35 - 72
50	70	42	84	71	53	64 -140
66	100	64	160	120	86	140 -250
Saturated	160	120	~500	240	230	255 -460
Saturated	220	150	Saturated	400	280	280 -620

Dose Interpretation (r) From Density On							Other Field Measurements (r) at Approximately the Same Locations
Du Pont D-1	LF-1	Kodak DF-7	DF-58	Minimax BS	Rinn EF-1	DC-1	
3.0	4.0	3.1	3.7	4.4	5.0	3.6	2.5- 4.5
5.5	6.8	6.2	7.1	6.8	9.0	7.2	4.9- 9.3
8.3	10	10	12	13	Saturated	11	9.4- 19
20	17	26	24	34	Saturated	27	18 - 37
37	Saturated	45	Saturated	Saturated	Saturated	Saturated	35 - 72
Saturated	Saturated	76	Saturated	Saturated	Saturated	Saturated	64 -140

quired for unit density, and the sensitivity to Co^{60} gamma radiation is arbitrarily set equal to unity. Computed values for the sensitivity of the dental films in special holders designed to reduce energy dependence (3) are shown for comparison. The energy dependence of the bare dental pack-

ets and of the roll films is seen to be very large. Interpretation of film density in terms of dose made on such material with the aid of high-energy density-vs.-exposure curves may therefore lead to a considerable overestimation of the dose of radiation containing a strong low-energy component.

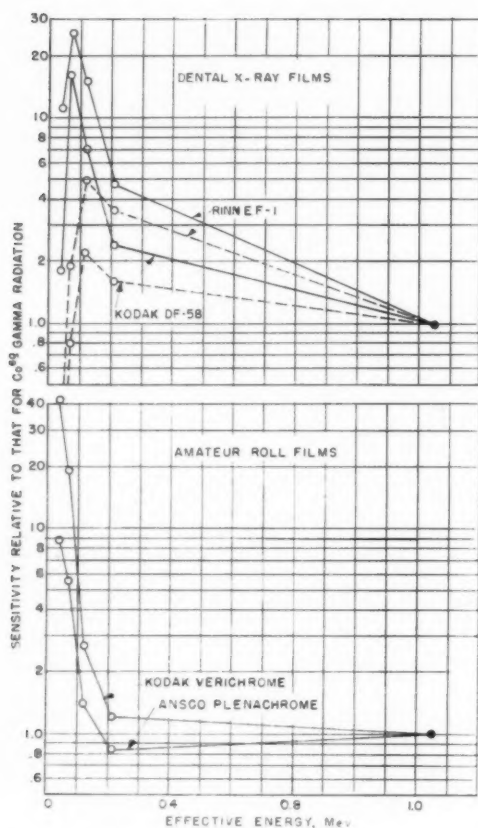


Fig. 3. Energy dependence. Solid lines: Bare dental x-ray film packets and amateur roll films. Dashed lines: Dental film packets in special holders (computed).

RESPONSE TO PROMPT RADIATION RELEASED IN FISSION

Both roll and dental films were exposed to prompt nuclear radiation, along with other dosimeters and survey instruments. The film response was interpreted

in terms of exposure by means of the density-vs.-exposure data shown in Figures 1 and 2. Table 1 shows the results of this study. Readings obtained on a number of other instruments at approximately the same positions are included for comparison. Agreement is satisfactory for an order-of-magnitude survey.³

ACKNOWLEDGMENT: The author wishes to thank Roscoe H. Goeke, of the Federal Civil Defense Administration, who acted as Director, Program 38, Civil Effects Test Group, Atomic Energy Commission, and John H. Tolan, Georgia Institute of Technology and Emory University School of Medicine, who served as Project Officer, Project 38.3, for the FCDA during the 1955 atomic series. They were responsible for positioning and recovering the films exposed to the prompt radiation from the detonation, and for performing the field measurements with other radiation instruments. Most of the experimental laboratory studies were conducted by Joe R. Brooks of the National Bureau of Standards.

Radiological Equipment Section
National Bureau of Standards
Washington 25, D. C.

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³ It may be interesting to note that, while the dental film data shown in the table were obtained on bare film packets, data were also obtained from a small number of dental films enclosed in the special holders. The response of the dental films in the holders was not included in the table because of lack of a comparison with other instruments. The data showed, however, that under the particular exposure conditions, the special holders did not improve the accuracy of the dose determinations.

SUMMARIO IN INTERLINGUA

Controlo de Radiation Atomic per Medio de Pelliculas Photographic Commercial e Pelliculas Roentgenographic Dental

Varie typos de pelliculas photo- e radio-graphic que es disponibile commercialmente pro le uso de amateurs in photographia e de dentistas esseva testate quanto a lor utilitate possibile in le determination del distribution de dosages de radiation in caso de disastro atomic in un

communitate urban. Le resultatos de tests laboratorial e del exposition in le campo practic al radiation prompte ab le detonation de un mecanismo monstra que iste pellicules es satisfactori pro le objectivos de determinaciones de intensitates relative.

The Artificial Kidney and Ion-Exchange Resins as Possible Methods of Removing Radioelements from the Body¹

W. B. LOONEY,² C. J. MALETSKOS,³
MARIE HELMICK,⁴ JOHN REARDON,⁵
JONATHAN COHEN,⁶ and WARREN GUILD⁷

The classic studies of Aub, Evans *et al.* (1) in 1938 in radioelement removal demonstrated that the renal clearance for radium was less than 1 per cent in twenty-four hours. This finding suggested the possibility that direct radioelement removal from the blood might prove to be an effective way of eliminating radioelements. Both the artificial kidney (2) and ion-exchange resins (3) afford means for radioelement removal, as well as providing an opportunity for extension of the work by Hastings and Huggins (4) on the mobilization of calcium in the circulating body fluids.

Preliminary *in vitro* experiments were performed to determine some of the parameters necessary to evaluate the feasibility of using either approach.

The first experiments were carried out on a simulated artificial kidney. Stable calcium, calcium 45, and ethylenediaminetetraacetic acid were readily dialyzable under conditions similar to those in the artificial kidney (calcium being omitted for the purpose of the present experiments) (5).

In later experiments solutions of strontium 85 and calcium 45 were passed directly through ion-exchange columns to determine the effectiveness of a synthetic cation exchange resin in removing these radioelements. Quantitative removal of strontium 85 and calcium 45 was obtained with the resin on a sodium cycle. Quantitative removal of these elements was also obtained with the resin on a calcium cycle. The advantages of the ion-exchange

column over the artificial kidney are its simplicity, its potentialities for more widespread use, and its greater selectivity for polyvalent cations over divalent and monovalent cations.

Biological Results: Radioelement removal has been attempted in dogs one hour, three days, seven days, and ten days after the intravenous injection of radiocalcium and radiostrontium (see Table I). The first dog (CK-121) was kept on the artificial kidney for six hours, during which time 41 per cent of the radiocalcium was dialyzed into the bath, while approximately 1 per cent of the estimated total skeletal calcium content was removed. Radioelement removal has been carried out in three dogs by circulating the blood through an ion-exchange column. Forty and 33 per cent of the radiocalcium was removed after three and seven hours respectively, on the column. The second dog (CK-123) apparently died from hypocalcemia after three hours since the rate of calcium removal was high. By reduction of the rate of blood flow through the resin column, the third dog was satisfactorily maintained seven hours. Strontium 89 was given three days and strontium 85 and calcium 45 were given one hour prior to placing the animal (CK-127) on the ion-exchange column. One week later the experiment was repeated (see Table I). The removal of calcium 45 and strontium 85 injected one hour prior to placing the dog on the resin column was 30 and 31 per cent respectively. Only 1.9 per cent of the strontium 89 injected three days before was removed during the three-and-a-half hour experiment. Less than 1 per cent of the injected dose of strontium 85 was removed from the same dog one week later.

Preliminary results from this study would seem to indicate that both the artificial kidney and the ion-exchange resin may prove to be effective methods of removal of radioelements from the body. In addition, they offer means for the study of the dy-

TABLE I: RADIOELEMENT REMOVAL FROM DOGS

Dog Number	Method	Time From Injection	Duration of Experiment, (hr.)	Removal Expressed as Per Cent of Injected Dose		
				Calcium 45	Strontium 85	Strontium 89
CK-121	Artificial kidney	1 hour	6	41		
CK-123	Ion-exchange column	1 hour	3	40		
CK-124	Ion-exchange column	1 hour	7	33		
CK-127	Ion-exchange column	1 hour	3.5	30	31	
CK-127	Ion-exchange column	3 days	3.5			1.9
CK-127	Ion-exchange column	7 days	5		Less than 1	

* The papers appearing under this heading were submitted for publication in November 1956. They were prepared for presentation in Section C, Forty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 5, 1956, but because of lack of time were not read.

namics of metabolism of these and other radioelements.

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¹ From the Radioactivity Center, Massachusetts Institute of Technology (supported in part by Contract AT(30-1)-952 with the U. S. Atomic Energy Commission), The Kidney Laboratory, Peter Bent Brigham Hospital, and The Huntington Memorial Laboratories, Massachusetts General Hospital, Boston, Mass.

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A Technic for Permanent Implantation of Radioisotopes¹

ULRICH K. HENSCHKE, M.D., Ph.D.

A technic for permanent implantation of small radioisotope sources for tumor therapy has been developed which improves greatly the accuracy of the implantation and of the dosimetry. Unloaded hollow needles, 15 cm. long, are first placed in and around the tumor. The implanted volume is determined by measuring with a ruler the separation of the needles and their outside length. The number of sources for the desired tumor dose is then figured. Next a special instrument with depth gauge is attached to each needle in turn. With it the desired number of radioisotope sources are introduced and properly spaced in the tissue.

This technic was used at the Memorial Center during the first nine months of 1956 in 28 patients, 16 of whom had a non-resectable carcinoma of the lung and 8 a non-resectable tumor in the abdominal cavity. The patients were discharged as soon as they had recovered from the operation and no post-operative x-ray therapy was given. On the basis of our experience, this has become the preferred radiotherapeutic method in all cases where non-resectable carcinoma is encountered at thoracotomy or laparotomy.

The new technic has been worked out for the permanent implantation of radon, Au¹⁹⁸, and Ir¹⁹² sources. Ir¹⁹² sources appear to be of special promise because their longer half-life of 74.5 days enables one to keep an available supply on hand for many weeks and decreases the radiation exposure to operating and nursing personnel. Experience with protracted x-ray therapy also appears to indicate that the protracted irradiation with Ir¹⁹² sources may be of greater therapeutic effect. Ir¹⁹² sources can be produced in much smaller sizes than radon or Au¹⁹⁸ sources, and protection problems are simplified by the lower half-value layer in lead (2.3 mm.). Because of the high cross section of the Ir¹⁹² it is also conceivable that inactive iridium sources might be implanted and the patient then be exposed to the neutron flux of a nuclear reactor.

¹ From Memorial Center, New York, N. Y. This work was supported in part by Cancer Research Grant CS 9369 from the National Cancer Institute of the National Institutes of Health, U. S. Public Health Service.

Dosimetry of Interstitial Implants¹

M. L. MEURK, A. JACOBSON, and R. I. SCHULTZ

This report presents several aspects of the dosimetry of interstitial implants now under investigation.

Paterson and Parker (1) data are applied directly to both planar and volume seed implants of 1 cm. spacing. This procedure was found to be valid for planes by calculating the intensity distribution at several distances for planar Ir¹⁹² seed implants of various sizes and comparing it to the net minimum dose given by Paterson and Parker. This dose, however, applies only to within 1 cm. of the edge of the implanted area. To compensate for this fall-off, the implanted area is taken to be 1 cm. longer and 1 cm. wider than the area to be treated.

The calculations were based on inverse-square-law attenuation and angular variations in intensity due to self absorption. Measurements made with a small ionization chamber showed that the attenuation curve for Ir¹⁹² gamma rays in water deviated noticeably from the inverse-square law only after 6 cm.

A similar study has been done by Shalek (2) for volumes implanted with Au¹⁹⁸ seeds. The dose de-

terminated for a cubic lattice of 1 cm. spacing was found to agree fairly well with the Paterson and Parker net minimum dose.

The Paterson and Parker tables have been extended to include areas up to 1,000 sq. cm. and volumes up to 1,000 c.c. The planar implant tables were extended according to the method outlined by Paterson and Parker. The extension of the volume implant tables, however, was derived by applying a method of extrapolation.

In addition to removable implants on both short- and long-lived radioactive sources, the use of permanent implants of long-lived radioisotopes is under study. Dose tables were developed for Ir^{192} relating the milligram hours accumulated at any time per initial milligram radium equivalent.

A nomograph has been developed to facilitate the consideration of all the physical factors involved in the interstitial use of Rn^{222} and Ir^{192} . It relates the desired implant volume, the strength and number of seeds, and the total dose delivered.

In addition to giving the radiologist the Paterson and Parker net minimum dose within the implanted volume, the advantage of a 6,000-r isodose surface is being investigated. Comparisons of the locations of the isodose surface are being made for the following assumptions: (a) that all radioactive material is concentrated at a point in the center of the volume; (b) that the activity is distributed uniformly throughout a sphere of the same volume as the implant; (c) that the activity is distributed in the volume according to the Paterson and Parker rules for volume implants.

Graphs and tables described above are available upon request.

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¹ From the Department of Physics, Memorial Center, N. Y.

Radiation Polymerization of Liquids¹

FRANK E. HOECKER, Ph.D., and IVAN WATKINS, B.S.

Radiation polymerization appears to offer interesting possibilities for studying certain aspects of the interaction between radiation and matter. In preliminary studies to be described below, x-rays generated in a 250-kv beryllium window tube and filtered by various thicknesses of copper have been used.

Several liquids were considered. Only one was found to be suitable for extensive study. This substance

is sensitive to both visible and x-radiation but when kept in the dark is stable for many months.

Each specimen of liquid was contained in a 1.5-c.c. gelatin capsule with a lead ball about one-half the diameter of the capsule. The lead ball served as a means of testing for the presence and quantitative extent of solidification. The capsules were irradiated with the longitudinal axis parallel to the direction of and in a small circle concentric with the center of the beam. Uniformity of irradiation of a group of capsules partially embedded in a small block of plastic foam was insured by rotation of the circle of capsules about the central axis of the beam.

The extent of polymerization within the capsule was in accordance with variations of x-ray intensity along the longitudinal axis due to inverse-square and absorption effects. Solidification occurs initially at the upper end of the capsule but, for higher voltages, not at the upper surface because of absence of electron equilibrium there. Inversion of the capsule permitted the lead ball, originally at the bottom, to fall through unsolidified liquid to the level of solid polymer. Numerical data were obtained by measuring the distance from the meniscus of the solid polymer to the final position of the ball. After an irradiation, the maximum difference in extent of polymerization among the capsules corresponded to 4 per cent of the total dose.

The sensitivity of the monomer varied inversely with the intensity and appeared to be an inverse exponential function of the energy.

After irradiation ceased, the rate of polymerization appeared to decrease exponentially, so that the amount of polymerization asymptotically approached the final value in about thirty minutes. The intensity of the incident beam determined the amount of "after-polymerization."

The experimental evidence reported above indicates that the mechanism of action is through the formation of long lived radicals which form macromolecules.

¹ From the Radiation Biophysics Program, University of Kansas.

Measurement of the Ratio E_m/J_m for Betatron Radiation

L. D. SKARSGARD¹, M.Sc., D. V. CORMACK², Ph.D., and H. E. JOHNS³, Ph.D., F.R.S.C.

Earlier measurements of the ratio E_m/J_m for Co^{60} radiation have been made at the Saskatoon Cancer Clinic by J. P. Bernier and the present writers. A detailed report of this work is being published in *Radiation Research*. The method employed in the measurement of the ratio for betatron radiation is essentially the same, with minor modifications to facilitate integration of the dose.

A small sample of carbon (20 gm.) was thermally isolated and supported in the path of the beam from

	E_m/J_m ergs/esu	ρ_m Calculated	ev W/ion pair
Earlier measurements for Co^{60}	$.1103 \pm .004$	1.005	$32.9 \pm .4$
Current measurements for 22-MEV Betatron	$.1039 \pm .004$	0.944	$33.0 \pm .4$
Current check for Co^{60}	$.1105 \pm .004$	1.005	$33.0 \pm .4$

the University of Saskatchewan 22-MEV betatron. The value of E_m , the energy absorbed per unit mass by the sample on exposure to a given amount of this radiation, was measured.

An ionization chamber having physical dimensions identical to those of the absorption sample was supported in the same position in the radiation beam. A measurement was made of J_m , the ionization produced per unit mass of air in the sensitive volume of the chamber by the same given amount of radiation.

If we apply the Bragg-Gray relation, the ratio of these two quantities gives an experimental determination of the product $W\rho_m$, where W is the average energy required to produce an ion pair in air and ρ_m is the ratio of the mass-stopping power of carbon to that of air. If, then, a value for ρ_m is calculated from theoretical considerations, we may determine W . A tabulation of results appears above.

It is interesting from a clinical point of view to compare the values of E_m/J_m for Co^{60} and betatron radiation. It can be seen from the values in the table that 6 per cent less energy is absorbed per gram for betatron radiation than for Co^{60} radiation for the same ionization dose. This difference is due to the change in the stopping-power ratio, ρ_m . ρ_m decreases with increasing photon energy because of the increasing importance of the polarization or density effect in carbon. The values of W for Co^{60} and betatron radiation differ by a negligible amount.

After completion of the betatron experiments, the apparatus, in its modified form, was used to remeasure E_m/J_m for Co^{60} radiation. The results obtained checked very well with the original measurements made by Bernier *et al.* and are an indication of the reproducibility of these measurements.

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A Stable, Low-Background, High-Efficiency Scintillation Counter for Analysis of Low Levels of Radon Concentrated by Adsorption on Charcoal¹

H. F. LUCAS, Jr.

Scintillation counters for the measurement of radon have been developed by Damon and Hyde

(1), Malvicini (2), and Van Dilla and Taysum (3). Marked improvement in stability was obtained at this laboratory by a modification designed to ensure a reproducible distribution of radon and its daughters within the counter. In addition, lower backgrounds were obtained by the use of steel for the counter shell and quartz for the window. The usefulness was further augmented by adsorbing the radon from gases, liquids, and solids on charcoal. The radon was then transferred to the scintillation counter with a small volume of helium.

The scintillation counter has a volume of 96 c.c. and is constructed from an inexpensive Kovar seal. It is coated on the inside with silver activated zinc sulfide to a thickness of 20 mg./sq. cm. for optimum pulse height. A clear quartz window having a transparent conductive tin coating on its inner surface is sealed on the open end of the counter.

It was found that, in the absence of the conductive tin coating, the negative voltage on the photomultiplier tube induced a charge on the quartz window which, in turn, concentrated thereon the decay products of radon. This caused a low counting efficiency, which varied considerably in the presence of gas impurities such as water vapor. The calculated efficiency of the counter for the case of radon in the gas phase and all the daughters on the window agreed well with the experimental value of 3.97 cpm/ μc radon obtained with non-coated windows and dry helium.

The counting efficiency obtained with aliquots of radon from two N.B.S. calibrated radium solutions was $5.42 \pm .06$ cpm/ μc radon (0.82 counts per alpha) for a counter with a coated window. This corresponds to the efficiency calculated for the case of radon in the gas and the daughters uniformly distributed on the counter walls and window. The efficiency and reproducibility of ten additional counters were obtained by comparing the counting rates of aliquots of radon from a large reservoir. The counting efficiency of any two counters was found to agree within 2 per cent, and the reproducibility for any one counter was ± 1 per cent. The counting efficiency has remained constant during the six-month period it has been observed.

The background counting rate of newly constructed counters is 0.08 cpm. This background is stable over long periods of time except as increased by RaDEF residues from high counting rate samples. Instrumental spurious counts contribute approximately 0.003 cpm.

Thus a stable, low-background, high-efficiency radon counting system has been developed. This system is suitable for the analysis of amounts of

radon as small as 10^{-14} c or, when charcoal adsorption is used, concentrations of radon in air as low as 10^{-16} c radon/liter.

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¹From the Radiological Physics Division, Argonne National Laboratory, Lemont, Ill. Work performed under the auspices of the Atomic Energy Commission.

An Automatic Brain Scanner for Use with Gamma-Ray-Emitting Isotopes

W. B. REID¹, M.A. and H. E. JOHNS², Ph.D. F.R.S.C.

Two scintillation detectors are simultaneously carried over the surface of a sphere which is concentric with the skull. The collimators for the detectors are arranged so that they accept only those gamma rays which emerge nearly normal to the skull. At present, RISA is being used as the tracer. However, any radioactive element which emits suitable gamma rays and which is preferentially absorbed by the tumor could be used with the scanner.

The number of counts received by the two detectors are continually subtracted, so that any asymmetry in the distribution of the tracer is immediately indicated. The difference in count rate from the left and right detector, as well as the total number of counts received from each, are recorded on a circular chart of a size comparable to that of the actual

head. By applying this chart directly to the patient's head, the point at which abnormal activity is observed on the chart may be located on the patient.

The patient is scanned while supine with his head immobilized in a sling, so designed that it does not interfere with the motion of the detectors. Two points on the record charts are marked to correspond to two points on the head. These points are sufficient for interpretation of the actual position on the patient of any abnormal activity indicated on the chart. While the scan is in progress, the operation of the machine is completely automatic.

The procedure, including time for setting up the patient, takes about forty minutes. Suitable scans are obtained with a dose of 250 microcuries of RISA. Scans are taken twenty-four hours after injection of the radioactive tracer.

While the device uses the same principle as is employed in manual scans with one detector, it incorporates all the features of an automatic scanning system. The scans are reproducible, since the angles of the detectors with respect to the patient are identical for each scan.

The scanner is operating in the Saskatoon Cancer Clinic and a second unit is being constructed for use in the Ontario Cancer Institute. Tests are being carried out on phantom models to establish the limits of the technic from a purely physical point of view. A complete description of the apparatus is being published elsewhere.

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MAXIMUM PERMISSIBLE RADIATION EXPOSURES TO MAN

A Preliminary Statement of the National Committee on Radiation Protection and Measurement

Since the publication of *NBS Handbook 59* on Permissible Dose from External Sources of Ionizing Radiation, the National Committee on Radiation Protection and Measurement (NCRP) has continued the study and review of its recommendations, particularly with respect to genetic effects and the possible shortening of average life expectancy due to radiation exposure of a larger fraction of the population. The NCRP proposals resulting from these studies had an important influence on the decisions reached by the International Commission on Radiological Protection (ICRP) in Geneva in April 1956, which resulted in a general lowering of the maximum permissible accumulated dose (MPD) for occupational radiation exposures, as well as for exposures of the population as a whole. These changes are in accord with the informal agreements reached by the ICRP in Stockholm in 1952.

The NCRP has now agreed upon the formulation of revised recommendations on maximum permissible doses which integrate the national and international views for practical application. The Committee is pleased to note that the findings of the ICRP are reinforced by the important information and data provided in the subsequent reports of the National Academy of Sciences and the British Medical Research Council.

The changes in the accumulated MPD are not the results of positive evidence of damage due to use of the earlier permissible dose levels, but rather are based on the desire to bring the MPD into accord with the trends of scientific opinion; it is recognized that there are still many uncertainties in the available data and information. Consideration has also been given to the probability of a large future increase in radiation uses. In spite of the trends, it is believed that the risk involved in delaying the activation of these recommendations is very small if not negligible. Conditions in existing installations should be modified to meet the new recommendations as soon as practicable, and the new MPD limits should be used in the design and planning of future apparatus and installations. Because of the impact of these changes and the time required to modify existing equipment and installations, it is recommended on the basis of present knowledge that a conversion period of not more than five years be adopted within which time all necessary modifications should be completed.

DEFINITIONS

For the purposes of this preliminary statement, the following tentative definitions are given:

Controlled Area. A defined area in which the occupational exposure of personnel to radiation or to radioactive material is under the supervision of a radiation safety officer. (This implies that a controlled area is one that requires control of access, occupancy, and working conditions for radiation protection purposes.)

Workload. The output of a radiation machine or a radioactive source integrated over a suitable time and expressed in appropriate units.

Occupancy Factor. The factor by which the workload should be multiplied to correct for the degree or type of occupancy of the area in question.

RBE Dose. RBE stands for relative biological effectiveness. An RBE dose is the dose measured in rems. (This is discussed in the forthcoming report of the International Commission on Radiological Units and Measurements.)

MPD RECOMMENDATIONS FOR OCCUPATIONAL CONDITIONS (CONTROLLED AREAS)

1. **Accumulated Dose.** The maximum permissible accumulated dose, in rems, at any age, is equal to five times the number of years beyond age eighteen, provided no annual increment exceeds 15 rems. Thus the accumulated MPD = $5(N-18)$ rems where N is the age and greater than eighteen. This applies to all critical organs except the skin, for which the value is double.

2. **Weekly Dose.** The previous permissible weekly whole-body dose of 0.3 rem, and the thirteen-week dose of 3 rems when the weekly limit is exceeded, are still considered to be the weekly MPD with the above restriction for accumulated dose.

3. **Emergency Dose.** An accidental or emergency dose of 25 rems to the whole body, occurring only once in the lifetime of the person, shall be assumed to have no effect on the radiation tolerance status of that person. (See *NBS Handbook 59*.)

4. **Medical Dose.** Radiation exposures resulting from necessary medical and dental procedures shall be assumed to have no effect on the radiation tolerance status of the person concerned.

MPD RECOMMENDATIONS FOR THE WHOLE POPULATION

5. The maximum permissible dose to the gonads for the population of the United States as a whole from all sources of radiation, including medical and other man-made sources, and background, shall not exceed 14 million rems per million of population over the period from conception up to age thirty, and one-third that amount in each decade thereafter.

Averaging should be done for the population group in which cross-breeding may be expected.

RECOMMENDATIONS FOR INTERNAL EMITTERS

6. In controlled areas, the permissible radiation levels for internal emitters will conform to the general principles outlined above. Where the critical organ is the gonad or the whole body, the maximum permissible concentrations of radionuclides in air and water will be one-third the values heretofore specified for radiation workers. Where single organs other than the gonads are regarded as the critical organ, the present maximum permissible concentrations will continue. For individuals outside of controlled areas, the maximum permissible concentrations should be one-tenth of those for occupational exposures. (Other changes in the maximum permissible concentrations for radionuclides may be introduced because of additional information developed since the publication of *NBS Handbook 52*.)

DISCUSSION OF REVISED RECOMMENDATIONS

7. The MPD for occupational exposure is based on the absence of detectable injury to the individual. It remains at its present level of 0.3 rem/week for the whole body. Where the dose in any week exceeds this value, a dose of 3 rems in thirteen weeks may be accepted. The thirteen-week period may start at the beginning of the calendar quarter or the beginning of the week during which the permissible weekly dose was exceeded.

8. The rules given in *Handbook 59* will be continued for operational and administrative purposes, but some of the rules will be modified by provisions related to an average yearly limitation of occupational exposure to external sources of ionizing radiation of 5 rems to the blood-forming organs, gonads, and lens of the eyes, and of 10 rems to the skin. The use of "5 rems" in the statement of the revised rules is for the purpose of design and administration. The critical limitation will be that defined for the total accumulated dose in paragraph 1 above.

9. If a person's occupational exposure is documented or otherwise known with reasonable certainty, he may be permitted to use his reserve exposure in accordance with paragraphs 1 and 2 above. In all other cases, he shall be assumed to have received his maximum accumulated dose as indicated in paragraph 1 above.

10. It is considered that with the current and proposed low levels of occupational exposure, it is presently not necessary to make special allowance for medical exposure in conjunction with occupational exposure. This consideration may later become important. The effects of medical exposures have long been considered by this Committee to be the responsibility of the attending physician; it is his responsibility to evaluate medical radiation exposure in relation to the health of the individual. (See *NBS Handbook 59*.)

11. In the determination of the population dose in the vicinity of radiation sources, proper consideration should be given to occupancy factor and to workload. The exposure of individuals outside of controlled areas may be integrated over periods up to one year.

12. While at the moment it is not feasible to determine the average exposure for the population with any reasonable accuracy, the adoption of some figure is necessary for planning purposes. For the immediate future, it may be assumed that the total integrated RBE dose received by all radiation workers will be small in comparison with the integrated RBE dose of the whole population. Furthermore, persons outside of controlled areas, but exposed to radiation from a controlled area, constitute only a small portion of the whole population. Therefore, if this small portion is assumed to receive yearly an average per capita dose of 0.5 rem, the total dose to the whole population from man-made radiations is not likely to exceed 10 million rems per million of population up to age thirty. (This assumes a dose of 4 million rems per million of population over this age period from background radiation.)

Jan. 8, 1957

EDITORIAL

C. Edgar Virden, M.D.

President of the Radiological Society of North America

Dr. C. Edgar Virden comes to the Presidency of the Radiological Society of North America after serving the organization long and faithfully in other capacities. He was for a number of years a most competent Chairman of the Committee on Refresher Courses. In 1952 he was elected to the Board of Directors and in 1955 served as its Chairman.

Though in his earlier years he was at various times a resident of Seattle, Wash., El Paso, Texas, Chicago, Ill., and Norton, Kans., Dr. Virden belongs unquestionably to Kansas City. He was born in Kansas City, Mo., on April 12, 1895, and spent his early school days in Kansas City, Kans. After a year at the University of Chicago, he transferred to the University of Missouri and received his A.B. degree from that institution. He was graduated from Northwestern University Medical School in 1920, served a student internship in Chicago Lying-In Hospital, and again returned to Missouri for a general internship in St. Joseph Hospital, Kansas City. Having entered general practice in Norton, Kans., he became interested in radiology and took his initial course in that specialty under Dr. Edward Blaine of Cook County Hospital, Chicago. In 1925, he became a member of the faculty of the University of Kansas as an instructor under the pioneer, Dr. J. L. McDermott. He was later made Assistant Professor of Radiology, a position which he still holds. He is Chief of the Radiological Service at St. Joseph Hospital, Consultant to the U. S. Public Health

Service in Radiology, and Director of the Tumor Control Clinic, Mercy Hospital, Parsons, Kans.

The Radiological Society of North America is by no means the first to recognize Dr. Virden as presidential material. He was President of the Jackson County (Mo.) Medical Society in 1945-46, of the Missouri State Medical Association in 1951-52, of the Missouri Division of the American Cancer Society in 1949-50, of the Kansas City Southwest Clinical Society in 1953-54, and of the American College of Radiology in 1950-51. He was Chairman of the Board of Chancellors of this last named organization in 1949. He is a Fellow of the Inter-American Congress of Radiology and of the American Geriatrics Society, and a member of the Kansas City Academy of Medicine, the fraternities Beta Theta Pi and Phi Beta Pi (medical), the Mission Hills Country Club, and the Kansas City Club.

At the very beginning of his medical career, Dr. Virden married Margaret Hughes, whose charm and ability have been a constant inspiration to him. They are the parents of two children, Herbert, who is associated with his father in the practice of radiology, and Virginia. Six grandchildren are among their proudest assets.

The Radiological Society has chosen wisely—a man of outstanding professional ability and experience, of high integrity, and gracious personality, who will serve it well.

IRA H. LOCKWOOD, M.D.



C. EDGAR VIRDEN, M.D.

President of the Radiological Society of North America

The Forty-Second Annual Meeting

The Forty-second Annual Meeting of the Radiological Society of North America, the largest yet to be held, was called to order in the Palmer House, Chicago, by the President, Dr. Clarence E. Hufford, on Dec. 3, 1956, and came to an end on Dec. 7. The total registration was 2,850.

The program, arranged by Dr. Hufford, had a wide appeal, offering material of interest to diagnosticians, therapists, physicists, and biologists alike. Separate sections (A and B) held simultaneous sessions each morning, Tuesday through Friday, and combined sessions of more general interest occupied the afternoons. A third Section (C), of particular interest to physicists, met Wednesday afternoon.

As in former years, the official opening of the Meeting was preceded on Sunday by the ever popular Refresher Courses on therapy and film interpretation. The first of these, in the afternoon, with Dr. J. W. J. Carpender of Chicago as moderator, dealt with "Fundamental Problems in Therapy." At the film interpretation session, in the evening, Dr. Merrill C. Sosman and Dr. Laurence L. Robbins, of Boston, presided, while a panel of experts—Dr. John A. Evans of New York, Dr. Cesare Gianturco of Urbana, Ill., Dr. Arthur J. Present of Tucson, Ariz., and Dr. David M. Gould of Little Rock, Ark.—wrestled with the problems of diagnosis.

Monday morning's opening assembly was the occasion of Dr. Hufford's presidential address on "Attitudes in Radiology," which will later appear in this journal. This was followed by another of the series of historical lectures which have added such interest to recent meetings of the Society, the subject for this year being Dr. Rollin H. Stevens, and the lecturer Dr. Clyde K. Hasley of Detroit, Mich. The Memorial Fund sponsored a special lecture entitled "Proton Irradiation of the Pituitary and Its Metabolic Effect," by Dr. Rollin K. McCombs of Berkeley, Calif. In conclusion, Dr. Wilbur Bailey of Los Angeles presented a report on the

"Present Status of Medical Care Insurance and Allied Problems."

The feature of the Monday afternoon session was a panel discussion on the "Practical Clinical Use of Radioisotopes," with Dr. Hymer L. Friedell of Cleveland, Ohio, as moderator. Two papers on therapy and one on electron beams in industrial processes followed.

On Tuesday morning, Section A was devoted to a symposium on neuroradiography arranged by Dr. Eugene Pendergrass of Philadelphia, who acted as moderator. A group of outstanding papers dealt with this subject in its many aspects. In Section B, the therapists and physicists were at the same time enjoying a symposium on "Radiological Units and Dosimetry." Tuesday afternoon's offering was a series of papers on various abdominal conditions and a symposium on the "Treatment of Bronchial Cancer," with Dr. L. Henry Garland as moderator.

The Annual Carman Lecture was delivered on Tuesday evening by Dr. Lowell Goin of Los Angeles, who spoke on "Science and Solitude versus Clinical Consultation," drawing upon his wide experience to emphasize the need for fuller utilization by the radiologist of the clinical aspects of disease. At the conclusion of his address Dr. Goin received an illuminated scroll to serve as a memento of the occasion. A departure from previous practice was the presentation at this time, rather than at the banquet, of the Gold Medal of the Society. The recipient was Dr. Lawrence Reynolds of Detroit, Mich., who was cited for the valuable contributions to radiology that have marked his illustrious career. The announcement of the Scientific Exhibit awards—detailed elsewhere in this issue—concluded the evening.

On Wednesday morning, Section A listened to a panel discussion on "Pediatric Radiology," planned and presided over by Dr. John W. Hope of Philadelphia. The entire panel participated in a discussion of Aganglionic Megacolon and Meco-

mium Ileus and Peritonitis, while individual panel members considered other pediatric problems. In Section B a group of papers on the "Biological Effects of Radiation" attracted particular attention in view of the recent widely publicized report of the National Academy of Sciences.

Three symposia were presented on Wednesday afternoon. Two of these were addressed to Sections A and B: one arranged by Dr. Sydney F. Thomas of Palo Alto, Calif., dealing with recent developments in chemotherapy and their combination with irradiation, and one under the direction of Dr. Howard B. Hunt of Omaha, Neb., on the management of patients with advanced cancer. Dr. Harold O. Wyckoff of Washington, D. C., presided at the third, which was devoted to reports of current work in the field of radiologic physics. These brief but timely reports appear under the heading "Work in Progress" in the January issue of RADIOLOGY.

Dr. Philip J. Hodes of Philadelphia served as moderator for Section A on Thursday morning. This session was devoted to "The Use of Contrast Media in the Diagnosis of Retroperitoneal Abnormalities." Included was a paper on "Complications of Retroperitoneal Contrast Studies," a subject which it is well to have brought occasionally to our attention. In Section B, a series of papers dealing with "Multimegavolt Radiations" proved especially interesting to those concerned with the betatron and linear accelerator and output measurements at the high energies afforded by such apparatus.

Thursday afternoon's session was divided between diagnosis and therapy, with a group of papers on Arteriography and Aortography, including a consideration of the hazards of the latter procedure, and a panel discussion conducted by Dr. Isadore Lampe of Ann Arbor, Mich., on present applications of Co⁶⁰ therapy.

Thursday evening the Grand Ballroom of the hotel, which during the day was given over to scientific presentations and the business of the Society, became the

scene of a delightful social occasion when members and their friends gathered for the annual banquet. After introducing the guests, following the dinner, Dr. Hufford called upon Dr. John Bouslog, who on behalf of the Past Presidents of the Society presented to Dr. Donald S. Childs, in recognition of his twenty-five years service as Secretary-Treasurer of the Society and Business Manager of RADIOLOGY, a handsome silver tray bearing the seal of the Society, the names of the donors, and the inscription "To Don S. Childs, with our appreciation and esteem."

As his last official act, Dr. Hufford turned over to Dr. C. Edgar Virden, the incoming President, the Pfahler Gavel of mastodon ivory, quoting the words of Dr. Pfahler on a similar occasion: "May this ornamental remnant of very old living tissue serve as an emblem of the durability of the work of our great Radiological Society and give hopeful inspiration to you, the incoming President."

Other officers elected for the ensuing year are: President Elect, Dr. Sydney J. Hawley of Seattle; First Vice-President, Dr. Richard Chamberlain of Philadelphia; Second Vice-President, Dr. Maurice Frazer of Lincoln, Neb.; Third Vice-President, Dr. Harold Tompkins of Los Angeles; Member of the Board of Directors, Dr. Charles Gray of Tampa, Fla.; Secretary-Treasurer, Dr. Donald S. Childs of Syracuse, N. Y.; Historian, Dr. Howard P. Doub of Detroit.

A fine musical program by a selected group from the Purdue Glee Club rounded out the evening.

The closing session of Section A on Friday morning was devoted to a panel discussion of fracture problems, with Dr. Edgar C. Baker as moderator and a panel of seven radiologists from different localities. A large audience attended, and a demand was voiced for further consideration of this important matter as a teaching service. Section B in closing considered Radiation Measurement in a symposium comprising four papers on various aspects of this subject.

The entire meeting was well planned and efficiently carried out, and to Dr. Hufford and all who assisted him great credit is due. The excellence of the scientific program was matched by the Refresher Courses and the Scientific Exhibits, reported on the following pages. The Commercial exhibits, listed

in an earlier number of RADIOLOGY (November 1956), were as always a center of attraction, and the co-operation of the manufacturers is again acknowledged. Radiologists in attendance at this meeting cannot but feel a renewed pride in their specialty.

The Scientific Exhibits

The Scientific Exhibits at the Forty-Second Annual Meeting were exceptionally good both in content and method of display. Additional floor space over last year provided better facilities for the viewers. Although the Scientific Exhibits were again open on Monday, Tuesday, and Wednesday evenings, attendance in these evening hours decreased over the previous year. Again, this Section displayed the key films of Refresher Course No. 2.

A most interesting exhibit, entitled "Case of the Day," was offered by Dr. Benjamin Felson and his staff. On each of four days, a diagnostic problem was presented and viewers were asked to submit diagnoses. The latter, numbering nearly one thousand in the four-day period, were audited each evening and each of the winners was presented with a badge. A tremendous amount of work was required in the preparation and daily audit of this exhibit, and for this the Society is indebted to Dr. Felson and his associates.

The work of the Secret Committee on Awards was difficult. The number of the awards, listed herewith, is an index of the quality of the exhibits.

Fundamental Investigation

Magna Cum Laude. A Clinical Study of Radiation Cataracts with Phantom Measurements. GEORGE R. MERRIAM, JR., M.D., AND ELIZABETH F. FOCHT, B.A., New York, N. Y.

Cum Laude. Physiological and Pharmacological Methods for Increasing Radiation Effects. RAYMOND R. LANIER, M.D., RICHARD W. WHITEHEAD, M.D., MANCOURT DOWNING, Ph.D., AND JANE GUM, B.S., Denver, Colo.

Certificate of Merit. A New Emergency Stretcher for Transportation of the Acutely Injured and Helpless Patient. J. T. LITTLETON, Sayre, Penna.

Certificate of Merit. Electronic Isodose Computer for Multiple Port Radiation Therapy. WALTER S. MOOS, Ph.D., AND GLEN SANDBERG, B.S., Chicago, Ill.

Honorable Mention. Development of Gastrointestinal Tract in Infants. JOHN S. BOUSLOG, M.D., Denver, Colo.

Clinical Investigation

Summa Cum Laude. Angiocardiography in Normal and Abnormal Hearts. BENJAMIN M. GASUL, M.D., E. H. FELL, M.D., R. F. DILLON, M.D., C. J. MARIENFELD, M.D., G. HAIT, M.D., H. G. BUCHELERES, M.D., AND V. VRLA, M.D., Chicago, Ill.

Magna Cum Laude. The Familial Occurrence of Pulmonary Alveolar Microlithiasis. MERRILL C. SOSMAN, M.D., Boston, Mass., G. D. DODD, Houston, Texas, W. D. JONES, Ashland, Ky., AND G. U. PILLMORE, Easton, Penna.

Cum Laude. Total Unilateral Pulmonary Collapse: A Study of the Roentgen Appearance in the Lateral View. MORTIMER LUBERT, M.D., AND GEORGE R. KRAUSE, M.D., Cleveland, Ohio.

Certificate of Merit. Roentgen Changes in Childhood Pulmonary Tuberculosis Under Drug Therapy. LAWRENCE A. DAVIS, M.D., AND WILLIAM C. ADAMS, M.D., Louisville, Ky.

Certificate of Merit. Intrathoracic Aneurysms in Children. EDWARD B. SINGLETON, M.D., DAN G. McNAMARA, M.D., AND E. WILEY BILES, M.D., Houston, Texas.

Honorable Mention. Upright Pressure Spot Films as an Important Part of Cholecystography. HERBERT H. VIRDEN, M.D., Kansas City, Mo.

Honorable Mention. Pseudohypoparathyroidism. NATHANIEL FINBY, M.D., JOSEPH V. CUSMANO, M.D., AND DAVID H. BAKER, M.D., New York, N. Y.

Honorable Mention. Contrast Examination of the Pharynx and Larynx. WILLIAM E. POWERS, M.D., HARRY H. MCGEE, M.D., AND WILLIAM B. SEAMAN, M.D., St. Louis, Mo.

Special Award (Non-Medical).

Cum Laude. Radiography in the Museum. CHARLES F. BRIDGMAN, Rochester, N. Y., AND HERBERT C. POLLACK, M.D., Chicago, Ill.

The following exhibits, though not voted awards, were commended by the Committee as unusually good and particularly deserving of study:

Multiple Barium Enema Technic for Colon Examination. BENJAMIN D. BRAUN, M.D., Chicago, Ill.

Oral Cholangiography: Its Contribution to Surgical Planning in Cholelithiasis. RAFAEL GOMEZ-ZALDIVAR, M.D., AND LAURA FARIÑAS, M.D., Habana, Cuba.

Fixed Filling Defects in the Cholecystogram. TED F. LEIGH, M.D., JOSEPH CHANG, M.D., RICHARD B. ELMER, M.D., AND JAMES V. ROGERS, JR., M.D., Atlanta, Ga.

Special mention was made of one other exhibit for its excellent documentation.

An Accidental Radiation Injury by PETER E. HIBERT, M.D., LEWIS G. ALLEN, M.D., WILLIAM R. ALLEN, M.D., AND DORIS A. KUBIN, M.D., Kansas City, Kans.

Other exhibits were:

Continuous Visual Monitoring of 2 Mev Rotational X-ray Therapy. J. ROBERT ANDREWS, M.D., PHILIP RUBIN, M.D., ROBERT W. SWAIN, B.S., AND JANET H. BISSEON, R.N., Bethesda, Md.

Hysterosalpingography. WILLIAM M. BRYAN, M.D., A. CULLEN RICHARDSON, M.D., AND GEORGE A. WILLIAMS, M.D., Atlanta, Ga.

Gas Insufflation as Aid in Visualization of Pelvic and Abdominal Morphology. JAMES W. BUTICE, M.D., Little Rock, Ark.

Patent Ductus Arteriosus: A Teaching Exhibit. CHARLES T. DOTTER, M.D., HERBERT E. GRISWOLD, M.D., AND MASAO TAMAKI, M.D., Portland, Ore.

Gallstone Obstruction: Roentgenographic Diagnosis. LEO S. FIGIEL, M.D., STEVEN J. FIGIEL, M.D., AND FRED K. WIETERSEN, M.D., Detroit, Mich.

Pneumoperitoneum as a Diagnostic Aid in the Diaphragmatic Area. NATHANIEL FINBY, M.D., BERNARD MAISEL, M.D., AND JOHN A. EVANS, M.D., New York, N. Y.

A New Hepatolienographic Agent. HARRY W. FISCHER, M.D., Iowa City, Ia.

Simultaneous Multisection Laminagraphy in Practice. KAMILLO FLACHS, M.D., AND PHILIP D. MASTERS, R.T., Buffalo, N. Y.

The Clinical Use of a Mechanical Isodose Calculator in Rotation Therapy. GILBERT H. FLETCHER, M.D., R. J. SHALEK, Ph.D., AND V. A. SAMPIERE, Houston, Texas.

Physiological and Pathological Rotation of the Kidney. BELA GONDOS, M.D., Washington, D.C.

Meconium Ileus, A Medical and Surgical Challenge. JOHN W. HOPE, M.D., C. EVERETT KOOP,

M.D., AND HARRY C. BISHOP, M.D., Philadelphia.

A Preliminary Study of Splenic Pulp Manometrics and Percutaneous Splenic Portagrams. FRANCIS C. JACKSON, M.D., JOHN L. HAPPEL, M.D., JOSEPH J. KLINE, M.D., Pittsburgh, Penna.

Cardiac Catheterization Spot Films—The Importance of Team Work in Their Interpretation. HAROLD G. JACOBSON, M.D., D. W. ESCHER, M.D., AND JEROME H. SHAPIRO, M.D., New York, N. Y.

Dacryocystography (Diagnostic Roentgenography of the Lacrimal Drainage System). BENJAMIN MILDER, M.D., AND BYRON H. DEMOREST, M.D., St. Louis, Mo.

Gross Specimen Transparencies on X-Ray Film. KARL J. MYERS, M.D., AND J. RICHARD CRAWFORD, B.Sc., Philippi, West Va.

Gamma Radioscopy. ROBERT R. NEWELL, M.D., AND JOSEPH KRISS, M.D., San Francisco, Calif.

Tumors of the Anterior Mediastinum. WILLIAM R. NICOLAY, M.D., AND HUGH M. WILSON, M.D., St. Louis, Mo.

The Roentgen Appearances of Post-Wertheim Complications to the Ureter. RICHARD E. OTTOMAN, M.D., WILLIAM N. HANAFEE, M.D., AND PAUL E. STOUT, Los Angeles, Calif.

High-Speed Bi-Plane Selective Angiocardiology. EVERETT L. PIRKEY, M.D., LAWRENCE A. DAVIS, M.D., AND LEONARD LEIGHT, M.D., Louisville, Ky.

The Increasing Scope of Bronchography with Dionosil. CAROLINE W. ROWE, M.D., Galveston, Texas.

Role of X-Ray in Diagnosis of Carcinoma of the Colon. EMIL H. SCHNAP, M.D., Buffalo, N. Y.

Radiation Therapy in Carcinoma of the Lung. PAUL J. TRIER, M.D., AND THOMAS A. WARE, M.D., Des Moines, Ia.

Motor Phenomena in the Distal Esophagus. BERNARD S. WOLF, M.D., RICHARD H. MARSHAK, M.D., MAX L. SOM, M.D., AND SIGMUND A. BRAHMS, M.D., New York, N. Y.

The Scientific Exhibits Committee wishes to express its appreciation to the many contributors to the Section. We are well aware of the tremendous amount of time and work that has gone into the preparation of the exhibits. We wish also to thank the Local Committee for its able assistance.

SCIENTIFIC EXHIBITS COMMITTEE

Everett L. Pirkey, M.D.

Benjamin D. Braun, M.D.

John F. Holt, M.D.

Ted F. Leigh, M.D.

Frederick W. O'Brien, Jr., M.D.

Ivan J. Miller, M.D., *Chairman*

Refresher Courses

The Refresher Courses were again an important feature of the Annual Meeting of the Radiological Society of North America. A total of 50 courses were enthusiastically attended. In some instances it was not possible to accommodate the audience in the room available for the course.

Because of the increased request for tickets for the first days, there were ten courses presented on Monday, Tuesday, and Wednesday, with nine each on Thursday and Friday. The afternoon session on Sunday, Dec. 2, was attended by 685. Attendance at the evening session was 792. On Monday there were 670 members and guests; Tuesday, 682; Wednesday, 624; Thursday, 537; and Friday's group numbered 486.

The names of those participating are repeated here in acknowledgment of their valuable contribution to the Forty-Second Annual Meeting of the Society:

J. W. J. Carpender, M.D.	Cesare Gianturco, M.D.
Merrill C. Sosman, M.D.	Arthur J. Present, M.D.
Laurence L. Robbins, M.D.	David M. Gould, M.D.
Clifford L. Ash, M.D.	Charles L. Ewing
Ralph M. Caulk, M.D.	George R. Krause, M.D.
Vincent P. Collins, M.D.	A. L. Orvis, Ph.D.
Morton M. Kligerman, M.D.	M. H. Wittenborg, M.D.
John A. Evans, M.D.	Averill A. Liebow, M.D.
	Carl B. Braestrup
	Charles W. Breimer, M.D.

Arthur Finkelstein, M.D.	G. W. Morgan
E. Dale Trout, D.Sc.	Harold Tivey, M.D.
John P. Kelley, B.S.	Charles W. Yates, M.D.
John H. Woodruff, Jr., M.D.	Clyde O. Brindley, M.D.
H. M. Parker, M.Sc.	John R. Hodgson, M.D.
Lawrence A. Davis, M.D.	George Lewis, M.D.
Colin B. Holman, M.D.	Donald S. Childs, Jr., M.D.
Mortimer Lubert, M.D.	John Reeves, M.D.
George R. Merriam, Jr., M.D.	James E. Lofstrom, M.D.
L. Henry Garland, M.D.	Robert Robbins, M.D.
Raymond R. Lanier, M.D.	Ted F. Leigh, M.D.
H. Stephen Weens, M.D.	Elizabeth F. Focht
Robert S. Sherman, M.D.	Lois Collins, M.D.
George H. Ramsey, M.D.	Frank L. Campeti, M.D.
Raymond Gramiak, M.D.	Everett L. Pirkey, M.D.
P. K. Knoefel, M.D.	Juan M. Taveras, M.D.
J. Stauffer Lehman, M.D.	Benjamin Felson, M.D.
	Lester W. Paul, M.D.
	Titus Evans, Ph.D.
	Leon O. Jacobson, M.D.
	Antolin Raventos, M.D.
	Jesshill Love, M.D.
	B. F. Kimball, Sc.D.

We also wish to thank sincerely the members of the Local Committee on Refresher Courses, headed by Dr. Robert B. Lewis, for their diligence and efforts in seeing that the program ran smoothly.

REFRESHER COURSE COMMITTEE

John R. Hodgson, M.D.
 Edith H. Quimby, Sc.D.
 Jack W. Walker, M.D.
 Robert D. Moreton, M.D., *Chairman*



ANNOUNCEMENTS AND BOOK REVIEWS

ANNOUNCEMENT AMERICAN BOARD OF RADIOLOGY

Candidates for certification by the American Board of Radiology who start their residency in 1956 will be expected to devote three years to formal residency training in an approved department of Radiology, *plus* one year of practice or additional training in order to be eligible to appear for examination by the American Board of Radiology.

Those individuals who may be called to military duty during their residency and have been assigned to a department of Radiology for one year or more, may substitute this time for the required one year of practice or additional training.

All candidates for examination after 1956 must have received *three* years' formal, approved residency training regardless of military duties.

AMERICAN COLLEGE OF RADIOLOGY

At the Mid-Winter Meeting of the Chancellors of the American College of Radiology at the Drake Hotel, Chicago, Feb. 6 and 7, Dr. Earl E. Barth will assume the position of Chairman of the Board, to which he was elected at the September Meeting in Los Angeles. He succeeds Dr. Earl R. Miller of San Francisco.

Dr. Barth is in the private practice of radiology in Chicago and is Professor of Radiology at the Northwestern University Medical School. During the past two years he has served as a member of the Executive Committee of the Board of Chancellors, and prior to that was Treasurer of the College for several years. He has been Vice-President and Chairman of the Executive Council of the American Roentgen Ray Society, and he served as Treasurer and member of the Executive Committee of the Fifth Inter-American Congress of Radiology in April 1955. He is currently chief consultant in radiology at the VA Research Hospital in Chicago.

ARIZONA RADIOLOGICAL SOCIETY

Newly elected officers of the Arizona Radiological Society are Dr. John Wilson, Tucson, President; Dr. James J. Riordan, Phoenix, Vice-President; Dr. R. Lee Foster, 1313 N. Second St., Phoenix, Secretary-Treasurer.

HOUSTON (TEXAS) RADIOLOGICAL SOCIETY

At the November 1956 meeting of the Houston Radiological Society the following were elected to office for the ensuing year: Gilbert H. Fletcher, M.D., President; Robert S. MacIntyre, M.D., Vice-President; Ervin W. Biles, M.D., Treasurer; John M. Phillips, Hermann Hospital, Houston 25,

Secretary. The Society meets on the fourth Monday of each month in the meeting room of the Doctors' Club of Houston.

MIAMI VALLEY (OHIO) RADIOLOGICAL SOCIETY

The 1957 officers of the Miami Valley Radiological Society are: President, H. F. M. Plaut, M.D., Dayton; Vice-President, Wm. H. Crays, M.D., Springfield; Secretary-Treasurer, H. D. Robertson, M.D., Miami Valley Hospital, Dayton 9.

SECOND INTER-AMERICAN MEDICAL CONVENTION

The Second Inter-American Medical Convention will convene at the Hotel El Panama, Panama City, Republic of Panama, April 13-15, 1957, under the sponsorship of the Medical Society of the Isthmian Canal Zone, a chapter of the American Medical Association. The program will be wide in scope, with papers from both North and South America. For details, address Wm. T. Bailey, M.D., Gorgas Hospital, Ancon, Panama Canal Zone.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE HEAD AND NECK IN ROENTGEN DIAGNOSIS. In 2 volumes. By EUGENE P. PENDERGRASS, M.D., Professor of Radiology and Chairman of the Department of Radiology, University of Pennsylvania; J. PARSONS SCHAEFFER, M.D., Ph.D., Professor of Anatomy and Director of the Daniel Baugh Institute of Anatomy, Emeritus, Jefferson Medical College; PHILIP J. HODES, M.D., Professor of Radiology, University of Pennsylvania. 1,826 pages, with 2,403 illustrations. Published by Charles C Thomas, Springfield, Ill. Second edition, 1956. Price \$37.50.

FUNDAMENTALS OF CLINICAL FLUOROSCOPY, WITH ESSENTIALS OF ROENTGEN INTERPRETATION. By CHARLES B. STORCH, M.D., Associate Attending Roentgenologist, Radiodiagnostic Department, Beth-El Hospital, Brooklyn, New York. A volume of 306 pages, with 318 illustrations. Published by Grune & Stratton, Inc., New York. Second revised edition, 1957. Price \$8.75.

SOME EFFECTS OF IONIZING RADIATION ON HUMAN BEINGS. A REPORT ON THE MARSHALLESE AND AMERICANS ACCIDENTALLY EXPOSED TO RADIA-

TION FROM FALLOUT AND A DISCUSSION OF RADIATION INJURY IN THE HUMAN BEING. From the Naval Medical Research Institute, Bethesda 14, Md., U. S. Naval Radiological Defense Laboratory, San Francisco, Calif., and Medical Department, Brookhaven National Laboratory, Upton, N. Y. Edited by E. P. CRONKITE, M.D., V. P. BOND, M.D., and C. L. DUNHAM, M.D. A monograph of 106 pages, with numerous illustrations (29 in color) and tables. Issued by the United States Atomic Energy Commission. Published by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., 1956. Price \$1.25.

ANNUAL REVIEW OF NUCLEAR SCIENCE. Volume 6. JAMES G. BECKERLEY, Editor, Schlumberger Well Surveying Corporation; MARTIN D. KAMEN, Associate Editor, Washington University Medical School; LEONARD I. SCHIFF, Associate Editor, Stanford University. A volume of 472 pages, with numerous graphs and tables. Published by Annual Reviews, Inc., in co-operation with the National Research Council of the National Academy of Sciences. On sale by Annual Reviews, Inc., Palo Alto, Calif., 1956. Price \$7.00.

DIAGNOSTICS PNEUMOLOGIQUES. By A.-P. JARNIOU, Professor agrégé du Val-de-Grâce, Chef du Service de Pneumo-phthisiologie de l'Hôpital-Percy, with a Preface by Dr. Roger Even, Médecin de l'Hôpital Laënnec. A monograph of 148 pages, with 28 roentgenograms on 14 plates. Published by G. Doin & Cie, 8, Place de l'Odéon, Paris VI*, 1956. Price 1,350 fr.

Book Reviews

PELVIMETRY. By HERBERT THOMS, M.D., Emeritus Professor of Obstetrics and Gynecology, Yale University School of Medicine, New Haven, Conn. A volume of 120 pages, with 45 figures and 4 tables. Published by Paul B. Hoeber, Inc., Medical Book Department of Harper & Bros., New York, 1956. Price \$5.00.

In this small, readable volume the author, whose name is one of the first to come to mind when pelvimetry is mentioned, gives a practical description of variations and abnormalities of the bony pelvis in relation to labor and describes procedures by which pelvic morphology and capacity can be ascertained. The work is concerned essentially with the clinical aspects of the subject. The centimeter grid method is given the chief—indeed almost sole—consideration.

The author emphasizes the value of an accurate pelvic survey for every primigravid woman, but it is difficult, from a genetic standpoint, to justify the radiation exposure involved in such a program.

This book will be of greatest interest to the obstetrician, but radiologists will find it an excellent reference source on the normal and abnormal pelvis.

RADIATION DOSIMETRY. Edited by GERALD J. HINE, Veterans Administration Hospital, Boston, Mass., and GORDON L. BROWNELL, Massachusetts General Hospital, Boston, Mass. A volume of 932 pages, with 306 figures and 114 tables. Published by Academic Press Inc., New York, 1956. Price \$22.00.

This volume is the work of twenty-two authorities, whose contributions have been arranged under three headings to form an integrated presentation of the important subject of Radiation Dosimetry.

The initial section, Fundamental Problems of Dosimetry, consists of three chapters. The first two deal with basic radiation physics in so far as it relates to problems of dosimetry. The third chapter is devoted to the biological and medical effects of radiation, covering the mechanism of the action on living cells, the reactions and tolerance doses for various normal tissues, and finally effects on malignant tissue. Maximum permissible levels of radiation are also explained.

The second section of the book—Radiation Detectors and Their Calibration—includes chapters on ionization chambers, Geiger-Müller counters, scintillation detectors, and film, chemical, and calorimetric methods. These are treated from the point of view of theoretical rather than applied physics; construction details are not given, but rather principles which must be borne in mind in the design and use of equipment. Applications and limitations of each method are mentioned. In this section, also, is a chapter on Survey Instruments and Pocket Dosimeters and one on Standardization of X-ray Beams and Radioactive Isotopes.

Contributions on Radiation Fields and Their Dosimetry make up the final section. The first of these, entitled X-rays and Teleisotope Gamma Rays, covers the production of radiation, back-scatter, depth dose, treatment plans, and rotation therapy. A second chapter describes sources of high-energy electrons, means of collimating and measuring electron beams, and their clinical and experimental uses. Neutrons and heavy charged particles are similarly discussed in subsequent chapters. The special problem of calculating tissue dose from internal isotopes is taken up. The last chapter is concerned with the practical problems of isotope shipment and disposal. Numerous tables of data useful in dosage calculation are included in an Appendix.

This volume covers a wide field in a thorough though necessarily brief manner. Mathematics is kept to a minimum, and the book may be read intelligibly by those with little training in this field. It should be of interest to research workers in radiobiology, health physicists, and those using radiation in industry.

INTRAVENÖSE CHOLANGIOGRAPHIE. GRUNDLAGEN, TECHNIK, ERGEBNISSE. By PRIV.-DOZ. DR. TH. HORNYKIEWYTSCH, Giessen. With a Preface by Prof. Dr. R. Janker, Bonn, and a Foreword by Prof. Dr. H. Bohn, Giessen. A volume of 160 pages, with 185 illustrations. Published by Georg Thieme, Stuttgart, 1956. Distributed in the United States by Intercontinental Medical Book Corporation, New York, N. Y. Price DM 54.—(\$12.85).

The fact that intravenous cholangiography has come of age is implicitly acknowledged by this monographic study, based on examinations performed between 1952 and 1956 on about 3,000 individuals (1,200 with and 1,800 without evidence of biliary disease). There seems to be an advantage in both spot-films (right anterior oblique, without compression) and body-section roentgenograms.

The volume is well written, adequately illustrated with excellent reproductions, and contains an up-to-date and fairly complete bibliography. It is recommended to both researcher and practitioner as a valuable reference source for this particular topic.

LES TUMEURS DE L'AMYGDALE ET DE LA RÉGION VÉLOPALATINE. By A. ENNUYER and J.-P. BATAINI, Médecins de la Fondation Curie. (Statistiques de la Fondation Curie. Exploitation Statistique by DR. FAUTREL). A volume of 536 pages, with 150 figures and 91 tables. Published by Masson et Cie, 120, Boulevard Saint-Germain, Paris-6°. Price 5,000 fr.

Between 1919 and 1948 there were 20,000 patients with malignant tumors treated by irradiation at the Curie Foundation. Of these, more than 800 had tumors of the tonsil and velopalatine region. This extensive monograph analyzes the results obtained in this latter group. The anatomy, incidence, clinical features, and surgical and radiotherapeutic aspects of these tumors are thoroughly presented. Treatment failures are also assessed.

The last part of the monograph includes 47 case histories of patients successfully treated for tumors described in the text. The clinical sketches of the lesions are of interest, especially to one who has been fortunate enough to see the careful sketches placed on each patient's chart at the Curie Foundation.

This monograph is one of the most thorough pre-

sentations of this group of tumors in the medical literature.

ATTUALE ORIENTAMENTO NELLA RADIODIAGNOSTICA DELLE MALATTIE TORACICHE. (POSSIBILITÀ E LIMITI DELLA COMUNE TECNICA RADIOLOGICA). DOTT. RENATO BEVILACQUA, Aiuto e Vice Direttore Incaricato, Consorzio Provinciale Antituberculare di Milano, Dispensario Centrale (Direttore, Prof. Mario Bello). A volume of 184 pages, with 175 figures. Published by Edizioni Minerva Medica, Torino, Italy, 1956. Price L. 3,000.

This short but very modern text is intended for the chest practitioner, and attempts to familiarize the reader with the fact that the three dimensions of space are flattened out to two on the roentgenogram. The first chapter is specifically devoted to the identification of the anatomic site of pathologic findings elicited on the standard frontal roentgenogram. It includes a tabulation of 566 cases of right middle lobe lesions seen between 1949 and 1955 in the anti-tuberculosis clinic of Milan; only 7 of these proved to be malignant, which is in keeping with the rarity of bronchogenic carcinoma in this location. The various types of segmental pneumonitis and interlobar exudate are particularly well covered, but the primary idea is to correlate the appearance on the frontal view with the lateral projection.

The second chapter, on chest roentgenoscopy, concerns mostly non-tuberculous lesions which cannot be studied properly without reference to one or more additional (oblique) projections, and pathologic findings (including tuberculous and other cavities) which are identified only on views other than the standard frontal, many of which, indeed, are not even suspected from the conventional postero-anterior roentgenogram. The third chapter describes several procedures for the roentgenoscopic localization of intrathoracic disease processes, adapted from similar methods used for foreign bodies. At a time when roentgenoscopy as a whole is being de-emphasized, one may be wise to prefer instead two projections, in frontal and lateral incidence.

Good paper and excellent reproductions enhance the value of this little book, the perusal of which may benefit even the more experienced in the field of chest roentgenology.

In Memoriam

WILLIAM ALBERT EVANS, M.D.

1907-1956

The writing of an obituary is an assignment accepted with mixed emotions. It may be a not unwellcome task to chronicle the events in the life of a senior citizen who has lived to see the fruition of his

efforts and to enjoy the rewards of his labors in the presence of his friends and a family well reared. It is with great regret, however, that we must record the untimely death on Oct. 14, 1956, of Dr. William A. Evans of Detroit, Mich. This young radiologist had already accomplished much but he gave promise of still greater service to the science and practice of his chosen profession. The son of an



William A. Evans, Jr., M.D.

illustrious physician and radiologist, Dr. William A. Evans, Sr., his preparation for a medical career was of the finest and well calculated to develop the brilliant mind inherited from both his parents.

Doctor Evans was born Jan. 14, 1907, at Belaire, Mich., where his father was then engaged in the general practice of medicine. His preparatory education was in the public schools of Detroit, after which he attended Williams College, being graduated in 1926. He received his medical degree from Johns Hopkins University in 1930, following which he served an internship in Peter Bent Brigham Hospital and spent a period of study in the University Medical Clinic at Würzburg. He returned to Peter Bent Brigham for additional training in internal medicine and was under the direction of the great Doctor Christian until 1936, when he became associated with his father and Dr. Lawrence Reynolds in Detroit.

Intensive study of radiology led to appointments to the radiologic staffs of Harper and Marine Hospitals, but the challenge of the problems of the radiology of children's conditions soon led to acceptance of a position as radiologist to Children's Hospital in Detroit. It was in this field that Dr. Evans did his greatest work in research, teaching, writing, and consultive practice. In addition to directing the Department of Radiology, he was for the past several years Chief of Staff of Children's Hospital.

His death has left a place in the scientific and administrative functions of that institution which is indeed difficult to fill.

Dr. Evans enjoyed a position as Assistant Professor of Radiology at Wayne State University, taking his responsibilities as a teacher most seriously. Fortunate indeed are those students, interns, and residents who had the privilege of his tutelage.

A seemingly tireless student, Dr. Evans made numerous and varied contributions to the literature. His earlier publications in the field of internal medicine, appearing in leading scientific journals, covered such subjects as myxedema, venous pressure, peptic ulcer, colitis, diuresis, salt and water metabolism, and included several papers on circulation and blood volume studies. His radiologic writings, more familiar to the readers of this journal, included some thirty additional articles, most of which dealt with some phase of pediatric radiology, although a number of general radiologic subjects were treated in their anatomical or physiologic aspects.

A member of the American Roentgen Ray Society, Dr. Evans was chairman of the Committee on Scientific Exhibits for the annual meeting, and was a member of the Executive Council. Included in his numerous affiliations were Fellowship in the American College of Radiology and membership in the Radiological Society of North America. He was a past president of the Detroit Roentgen Ray and Radium Society.

Doctor Evans served nearly four years in the Medical Corps of the United States Army. He was Radiologist and Senior Medical Officer at the Detroit Induction Center, and later was Radiologist to large military hospitals in this country as well as in the Pacific theatre of operations, where he served in New Guinea, the Philippines, and Japan. His retirement rank was that of Lieutenant Colonel.

Doctor Evans had unusual opportunities for travel and study, and the cultural side of life attracted to him a host of artistic and intellectual friends. He was an accomplished musician, and possessed a high degree of critical judgment in the fields of music, art, and literature. His marriage to Charlotte Cushman, of similar cultural attainments, resulted in a home life delightful to those fortunate enough to enjoy their hospitality.

In addition to his wife, Doctor Evans is survived by a daughter, Elizabeth, and by his mother. His mourners include those of high and low estate, for his benefactions were many and his contacts cosmopolitan. The loss to his immediate associates is irreplaceable.

E. WALTER HALL, M.D.

CHARLES L. HINKEL, M.D.

1910-1956

Dr. Charles L. Hinkel of Danville, Penna., director of the Department of Radiology at Geisinger

Memorial Hospital and the Foss Clinic in that city, died suddenly of coronary occlusion at his home on Dec. 10, 1956. Dr. Hinkel was forty-six years of age. He was born in West Grove, Penna., in 1910, received his undergraduate education at Gettysburg College and his M.D. degree from the University of Pennsylvania in 1936. After an internship at Geisinger Memorial, he took his radiologic training at Columbia Presbyterian Medical Center from 1937 to 1940, and for two years was on the faculty of the College of Physicians and Surgeons, Columbia University. He then entered the private practice of radiology. He was on active duty with the U.S. Army Medical Corps from 1942 to 1946, attaining the rank of Lieutenant Colonel and receiving the Bronze Star Medal for service in Army radiology during World War II. He became director of the department of radiology at Geisinger Hospital in 1946.

Dr. Hinkel's zeal in scientific work is indicated by the fact that he published over forty papers on widely varying subjects in radiology and seldom missed an occasion to have an outstanding exhibit at state and national scientific assemblies. He was a fellow of the American College of Radiology and Counselor from that organization to the American Society of X-Ray Technicians. He was a member of the Radiological Society of North America and of the Pennsylvania State Radiologic Society, as well as of other medical organizations.

While Dr. Hinkel will be greatly missed by his colleagues because of his outstanding scientific attainments, his loss will be felt even more keenly by



Charles L. Hinkel, M.D.

the circle of his friends. His capacity for friendship and his attainments as a good citizen were of the first order.

CARL B. LECHNER, M.D.



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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Concerning the Roentgen Diagnosis of Intracranial Dermoids (So-called Cholesteatoma). H.-E. Schulze. Fortschr. a. d. Geb. d. Röntgenstrahlen **84**: 440-446, April 1956. (In German) (Johannisallee 35, Leipzig-C 1, Germany)

The extradural epidermoid or cholesteatoma of the cranial vault seldom presents diagnostic difficulties. It tends to erode the bone at an early stage, causing pressure defects of the inner and outer tables, with sharp demarcation and marginal sclerosis. The rare intracranial epidermoid, on the other hand, is hardly ever recognized before operation, and the impression therefore prevails that roentgenography is not helpful in the diagnosis. The author, however, was able to make a correct preoperative diagnosis in a series of 11 cases.

Survey films failed to contribute specific information. In some cases, there was evidence of increased intracranial pressure, as well as non-specific peripheral tumor calcification, especially of the capsule. In a suprasellar location, this calcification could not be differentiated from a craniopharyngioma.

Pneumoencephalography and ventriculography were of help only after encroachment of the tumor upon the ventricular system. In such instances, especially with associated tear of the slowly expanding avascular tumor capsule, the air produced a characteristic scalloped contour of the protruding cholesterol masses. Shift of the ventricular system rarely occurred, even when the tumor was large. This was believed to be due to the very slow process of expansion, which resulted in atrophy of the surrounding brain tissue instead.

Cerebral angiography was most useful in the detection of peripheral as well as centrally located tumors. The findings were those of space-occupying avascular lesions, consisting in marked displacement and distortion of cerebral vessels, with little if any ventricular shift. In view of the avascularity of the capsule, there was practically no tumor staining. In only 1 of the 11 cases was distinct tumor staining observed.

Four roentgenograms; 3 tables.

ERNEST KRAFT, M.D.
Newington, Conn.

The Surgical Treatment of Intracranial Aneurysms. Results in Angiographically Located Lesions. Wallace B. Hamby. Arch. Neurol. & Psychiat. **75**: 345-349, April 1956. (University of Buffalo School of Medicine, Buffalo, N. Y.)

This report concerns 69 patients with intracranial aneurysm demonstrated by cerebral angiography. Fifty-one received definitive operative therapy with a mortality rate of 22 per cent. The other 18 received no definitive therapy and mortality reached 72 per cent. Moderately detailed autopsy accounts are given for the patients who did not survive operation. Surgical procedures utilized are commented upon.

The author concludes that persons with angiographically demonstrable aneurysms are best treated by definitive surgery. Prognosis is best in those who have had no bleeding prior to operation. If subarachnoid hemorrhage has occurred from the aneurysm, then the mortality rate appears to decrease as the length of time before surgery increases. The first week after hemorrhage is

particularly critical; in this series 72 per cent of patients operated in that period died.

It is felt that the operation of choice is occlusion of the aneurysmal neck whenever possible, with maintenance of the existing arterial circulation. Branches of the artery are sacrificed by occlusion with silver clips only when the neck of the aneurysm cannot be closed.

Three tables.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Inflammatory Craniopathies. Various Stages in the Development of a Theory. Mario Bertolotti. Riv. ital. di radiol. clin. **6**: 55-105, April-May-June 1956. (In French) (Istituto di Radiologia, Università di Napoli, Naples, Italy)

This lengthy article, the title of which has been rather freely translated, is reprinted from another Italian journal. It is based on the assumed pathogenetic relationship between paranasal sinusitis and inflammatory craniopathies. To emphasize the practical importance of the problem, it is stated that latent sinusitis in children is of more common occurrence than suspected, and could be more frequently demonstrated by use of the vertico-submental projection in routine examination of the sinuses. Hyperostosis frontalis interna of the Morgagni type (hyperostotic endocraniosis), sometimes called "adjacent osteal reaction," is interpreted as a response of the bony cortex to an underlying chronic ethmoidosphenoidal inflammation. The perisinus reaction, i.e., of the posterior ethmoid and surrounding structure of the sphenoid, is supposed also to be responsible for other disturbances, such as retrobulbar neuritis, various forms of neuralgia, migraines, and recurrent headaches.

Oxycephaly due to craniostenosis is also said to originate as an inflammatory process, the latter being either congenital, the result of a prenatal meningo-pathy, and associated with morphologic anomalies, or acquired in early infancy, when it is related to a leptomeningitis, propagated through Waldeyer's lymphatic ring from a primary chronic pansinusitis.

An exhaustive discussion is concerned with the underlying causes of frontal hyperostosis: Is it due exclusively to a frontobasilar hyperergic inflammation (Lunedi's theory) or to a mysterious primary degenerative factor of endocrine origin (Pende's hypothesis), or can both an inflammatory and a metabolic pathogenesis (Greppe's compromise) be accepted? In the author's opinion, the background is always inflammatory (leptomeningeal involvement following ethmoidosphenoidal sinusitis), and only occasionally is there an allergic component. In a later stage, when the pituitary is also affected, the secondary hormonal reaction will result in acromegaloform in the male, and in frontal endocraniosis in the female.

Among related problems is the *ethmoidism* (dysmorphism of the paranasal sinus system) caused by hormonal dysfunction of the hypophysis, affected by "phlogistic adenoidosis," a vicious circle which later may result in endocraniosis or other secondary hormonal disturbance, as for instance the so-called hyperthyroidism of Pende, which on close inspection of the skull roentgenograms will present all the classical signs of Frölich-Babinski's adiposogenital syndrome. *Patho-*

logic metopism (persistence of the mediofrontal metopic suture), allegedly due to an underlying inflammatory process, is often said to be associated with hypoplasia or even agenesis of the frontal sinuses. The occasional development of adenoidosis after closure of the metopic suture explains the absence of metopism in some cases.

This paper, while reminiscent of medieval scholastic subtleties, is undoubtedly based on the life-long experience of a clinical roentgenologist. The final argument cites Thomas Jefferson (who did not seem to think much of medicine as a science) and ends with the statement that in half a century, roentgenology has changed medicine to an extent never imagined by Jefferson.

Twenty-two roentgenograms; 7 drawings.

E. R. N. GRIGG, M.D.

Cook County Hospital, Chicago

A Clinical and Radiological Study of Choanal Polyp.

D. F. Reynolds and H. J. Groves. *J. Fac. Radiologists* 7: 278-285, April 1956. (St. Mary's Hospital, London, W. 2, England.)

Conventional radiographs of the head show choanal polyp surprisingly well at times. On a lateral view a polyp arising from the antrum may be outlined superiorly by an air streak between it and the nasopharyngeal roof. The polyp may be demarcated by the soft palate antero-inferiorly and by air postero-inferiorly. A trickle of iodized oil in the nasopharynx will separate the shadows of polyp and palate. Such polypi often change in position on films made during phonation or deglutition.

Most patients with a solitary polyp also have mucosal changes in sinuses other than that containing the polyp. On the occipitomeatal view there may be general clouding of the nasal passages medial to the antra. Obliteration of the paranasal air streak is usually noted. Increased density over the incisor teeth is common. A submentovertical view may help to confirm the side of origin.

Among differential possibilities, the ear lobe and the posterior end of the inferior nasal turbinate must be considered. The long axis of the latter points backward while that of the polyp points downward. A nasal sinus carcinoma may resemble a polyp but often shows evidences of bone destruction.

Seventeen illustrations, including 14 roentgenograms.

DON E. MATTHIASEN, M.D.

Phoenix, Ariz.

The Technique of Sialography. A. Robinson Thomas. *Brit. J. Radiol.* 29: 209-212, April 1956. (Newton Abbot Hospital, Devon, England)

A brief historical review of the development of sialography is presented by the author, who comments on the fact that little has been published in the literature on the actual technic of injection. He prefers the use of a Myers' lacrimal duct syringe, because it is easy to handle and the conical shoulder of the needle forms a stop to prevent regurgitation. His medium of choice is non-viscous Neohydriol.

The actual procedure begins with localization of the orifice of the parotid duct by noting the ejection of a bead of saliva after digital pressure is applied to the gland. This is repeated and, as the orifice opens a second time, a piece of horse hair is slipped into the duct. Two or three more hairs are then introduced for the purpose of dilating the duct. The syringe with the needle is inserted immediately after an assistant re-

moves the hairs. Injection proceeds until the patient complains of fullness in the side of the face. This usually occurs after the injection of 1.0 to 1.5 c.c. of oil. The skin over the gland is then massaged to assist filling, and the buccal mucosa is wiped to remove excess oil. The patient now grips the syringe with his teeth, and lateral films are taken. After removal of the syringe, repeat lateral views are obtained, together with any other views which are thought necessary.

The author claims that the method is painless, and any apprehension on the part of the patient is easily allayed by reassurance.

Four photographs.

JAMES NICHOLS, M.D.

Cleveland City Hospital

Fracture of the Odontoid Process. Report of Sixty-Three Cases. Edwin W. Amyes and Frank M. Anderson. *Arch. Surg.* 72: 377-393, March 1956. (Neurological Service of Los Angeles County Hospital, Los Angeles, Calif.)

Although fractures of the odontoid are popularly believed to be of rare occurrence, the authors culled a series of 53 examples from a total of 464 fractures, dislocations, or "fracture-dislocations" of the cervical spine. These occurred in 392 patients seen in the fifteen-year period 1939 to 1954. The incidence is even more striking when it is considered that only 152 of this group suffered trauma to the upper cervical spine. Ten additional cases of odontoid fracture (4 from the same service treated subsequent to 1954 and 6 from neighboring hospitals) are included in the study, making a total of 63.

If the patient was not unconscious or disoriented, his immediate complaint was severe pain in the neck or suboccipital region. The onset followed hard on the heels of the accident but occasionally was delayed for as long as twenty-four hours. Nuchal rigidity and resistance to neck motion were marked. Soft-tissue swelling and localized tenderness were occasionally noted but varied in location. Of the 58 patients who survived, 5 had neurological signs. These ranged from numbness in the occipital region to transient quadriplegia.

Minimal radiographic studies of the odontoid and the axis should include open-mouth and lateral views. It is essential that a clear view of the bony detail of the odontoid-body junction be obtained. To this end, it would not be amiss to obtain routine planigrams in all cases of moderately severe trauma to the upper cervical spine. Laminagraphy may reveal the fracture without the delay occasionally involved when the injury to the odontoid becomes evident on the plain film only after a degree of bony resorption has occurred. The dens may also be demonstrated by use of a dental film placed against the anesthetized posterior pharynx.

Among the immediate complications of odontoid fracture are dislocation in any direction, compression of the spinal cord or of the anterior spinal or one or both vertebral arteries, hemorrhage within or outside the spinal canal, and contusion or tearing of the nerves or muscles of the pharynx. Delayed complications include insidious or sudden luxation incident to failure of the fracture to heal, chronic, incomplete or recurrent compression of the spinal cord, infection (osteomyelitis, meningitis), excessive callus formation at the fracture site, avascular necrosis, and chronic adhesive arachnoiditis.

For avoidance of complications, careful roentgen

follow-up is indicated. When persistent callus surrounds the fracture site, planigrams may reveal an underlying ununited fracture line. Lateral films with the head extended and flexed will help establish the stability of the atlantoaxial joint and determine the length of time necessary for the wearing of a collar following initial traction.

Of the 58 survivors in this series all but 3 showed healing or immobilization of their fractures in from four to nine months of treatment consisting of traction followed by application of a collar. The 3 failures are attributed to inadequate or improper treatment.

Thirteen roentgenograms; 4 tables; 1 graph.

SAUL SCHEFF, M.D.
Boston, Mass.

THE CHEST

The Lordotic Position in Fluoroscopy and Roentgenography of the Chest. Berkeley Zinn and James Monroe. *Am. J. Roentgenol.* **75**: 682-700, April 1956. (J. M., Ray Brook State Tuberculosis Hospital, Ray Brook, N. Y.)

The fact that the lordotic position in fluoroscopy and roentgenography of the chest will give information concerning the extent and distribution of apical pulmonary disease is well known. There are, however, other applications which are well demonstrated here. Mentioned especially are cavities in the upper lung, and sometimes those in the middle and lower lung areas; anterior mediastinal lung herniation, which may not even be suspected on the usual postero-anterior projection; adhesions not otherwise visible, in the presence of pneumothorax; collapse of the right middle lobe; a collapsed left lower lobe which may be obscured by the heart on the usual views. This position also enables better demonstration of substernal thyroid enlargement and outlining of the pulmonary outflow tract. Anatomic variations in the upper ribs, upper dorsal and lower cervical spine, and apical pleural attachments may be better evaluated than on the conventional films.

The fundamentals of localization of an object or lesion, on the basis of the postero-anterior and lordotic pair of roentgenograms, are described. Positioning and roentgenographic technics for accurate and reproducible results are given in detail.

Forty-five roentgenograms; 2 diagrams.

JOHN R. RIESSER, M.D.
Springfield, Ohio

Roentgenologic Method for Demonstration of Bronchopulmonary Segments in Fully Expanded Cadaver Lungs in Situ. Kuo-York Chynn and L. R. Sante. *Am. J. Roentgenol.* **75**: 779-784, April 1956. (L. R. S., 606 Missouri Theatre Building, St. Louis 3, Mo.)

The authors illustrate a suspension apparatus and cassette holder, whereby a cadaver may be suspended in the erect position while roentgenograms are made for study of the bronchopulmonary segments. Prior to this the bronchi and bronchioles are bluntly dissected free with minimal possible damage to the adjacent lung tissues. One bronchiole of a certain bronchopulmonary segment is selected and ligated with silk sutures. Into this a cannula of corresponding diameter is inserted distal to the ligature and secured in the lumen by a second ligature. The opaque medium,

consisting of 70 per cent Urokon solution with a water-soluble color paste, is then injected into the segment through the cannula. The cannula is withdrawn and the bronchiole is ligated to prevent back-leakage of the opaque material. A rubber tube is then inserted through the mouth into the upper portion of the trachea, which is secured to the tube by a ligature. The sternum is replaced in position and the pericardium sutured to the sternum.

The cadaver is erected by means of a pulley and held against a 14 X 17-inch cassette holder. The lungs are fully inflated through the rubber tube, by means of an electric air-pressure pump. Roentgenograms of the chest in postero-anterior and lateral projections are obtained. The authors believe that this procedure affords a satisfactory means for roentgenographic investigation of segmental anatomy.

Six roentgenograms, 1 photograph.

A. O. MILLER, M.D.
Louisville, Ky.

Lung Compartment Determination. John C. Kovach, Victor Avedian, George Morales, and Peter Poulos. *J. Thoracic Surg.* **31**: 452-457, April 1956. (J. C. K., Cardio-Pulmonary Laboratory, Surgical Service, Triboro Hospital, N. Y.)

The authors describe a method of calculating the total lung capacity from a single postero-anterior chest film taken in maximal inspiration. The volume of the thoracic cage is calculated by considering it a paraboloid of revolution. From this are subtracted the volume of the diaphragmatic domes (considered the sum of two half segments of a sphere), the heart (considered a paraboloid of revolution), the superior mediastinum and adjacent vertebral bodies (with cross section considered a segment of a parabola), posterior mediastinum (considered of rectangular section with a depth of 6.1 cm.), and the lung parenchyma and contained blood (estimated on the basis of the patient's size).

In 22 clinically normal subjects, total lung capacity obtained from spirometric studies and residual air determinations was compared with calculated capacity. The results agreed closely, with a maximum difference of 1.70 per cent. No data on cases of lung disease are presented, but the authors state that the method is applicable to all forms of chest pathology, giving a more accurate estimate of a patient's normal lung capacity than can be obtained from charts based on averages of normal patients or body surface area.

One roentgenogram; 3 diagrams; 2 tables.

CAPT. GARTH R. DREWRY
U.S.A.F. Hospital, Tampa, Fla.

Roentgenologic Evaluation of Pulmonary Function. A Correlation with Physiologic Studies of Ventilation. Robert P. Barden and Julius H. Comroe, Jr. *Am. J. Roentgenol.* **75**: 668-681, April 1956. (R. P. B., 8835 Germantown Ave., Philadelphia 18, Penna.)

The basic terminology of pulmonary physiologic study is reviewed, and physiologic tests of pulmonary function are discussed. Correlation with roentgen study of the chest demonstrates the potential contributions of the radiologist to assessment of pulmonary functional status in the individual patient. The ready availability of roentgen equipment makes for advantages in convenience, and saving in time and expense, when evaluation of pulmonary function by physiologic

tests would be not only more difficult but perhaps less accurate.

Roentgenologic studies toward this end encompass usual routine chest films for the demonstration of anomalies in development of vertebrae and ribs, scoliosis, residuals of trauma to the rib cage, pleural thickening, mass lesions in the lung, edema or infiltration, and changes in position or mobility of the diaphragm; fluoroscopic evaluation of rib motion, diaphragmatic excursion, the rate, extent and symmetry of changes in various parts of the lung during quiet and forced breathing, cough, and alteration of intrathoracic pressure by the Valsalva and Müller procedures, all of which concern pulmonary ventilation; planimetric studies for information as to lung volume factors considered.

Seven case reports are included showing the application and limitations of roentgen evaluation of pulmonary function. Several are concerned with mechanical abnormalities interfering with ventilation. An asthma-like situation with expiratory difficulty accompanied by bronchographic study, a large bronchogenic carcinoma which occluded the entire left main bronchus, with change in position, and pulmonary fibrosis in association with sarcoidosis are other examples described. Physiologic data are quite complete for five of the cases.

The authors conclude, "... static shadows recorded on roentgenograms ... should be interpreted in terms of the functional changes which they imply. By recognizing the physiologic implications which may be derived from anatomic roentgen shadows, one clothes this evidence with new significance." The original paper can be read with profit.

Ten roentgenograms; 1 table.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Secondary Vascular Changes in the Lungs. Marcy L. Sussman and Thomas T. Frost. *Am. J. Roentgenol.* 75: 758-766, April 1956. (M. L. S., 1130 E. McDowell Rd., Phoenix, Ariz.)

Severe cases of mitral stenosis and/or insufficiency, chronic cor pulmonale, and some congenital cardiac lesions have in common pulmonary hypertension and right ventricular hypertrophy. Cardiac catheterization reveals also an increased pulmonary resistance. Structural vascular changes in the lungs in these conditions as they pertain to decrease in pulmonary flow and increased pulmonary artery pressure are the subject of this paper.

Seventy-one cases of chronic cor pulmonale seen at autopsy were reviewed for study of pulmonary vessels. By definition this condition consists in hypertrophy of the right ventricle as a result of pulmonary disease, any right ventricle of 5 mm. thickness or over being regarded as hypertrophied. Twenty-four of the cases showed moderate to severe changes in the arterioles, including muscular hypertrophy of the media, subendothelial fibrosis, hyalinization, and atheroma. Simple intimal fibrosis is not considered significant, since it appears to be a part of the normal aging process in pulmonary vessels and did not bear any relationship to severe pulmonary disease.

There was no correlation between the vascular changes described and the degree of right ventricular hypertrophy or the severity of the clinical findings. It is stated that "cardiac enlargement as determined roentgenologically is not a feature of cor pulmonale."

These vascular findings are contrasted with those in mitral stenosis, where there is proliferation of the intimal endothelium of arteries, increase in intimal connective tissue with vascularization, and medial hypertrophy with scarring.

A case of a congenital cardiac lesion without shunt showed a severe degree of pulmonary hypertension. Histologic study demonstrated a marked arteritis with narrowing of the arterial lumens. This was felt to indicate a persistence of the thick-walled fetal type of pulmonary vessel rather than an inflammatory reaction.

The applicability of pulmonary angiography to the study of pulmonary vascular patterns in cor pulmonale and mitral disease is mentioned.

Seven photomicrographs; 2 tables.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Preoperative Diagnosis of Sequestration of the Lung by Aortography. Leo J. Kenney and William R. Eyer. *J.A.M.A.* 160: 1464-1465, April 28, 1956. (Henry Ford Hospital, Detroit 2, Mich.)

This paper reports a case of sequestration of the lung involving the posterior basal segment of the left lower lobe. An aortogram, with the needle at the 12th thoracic segment and its bevel directed upward, showed an anomalous vessel arising from the aorta between the 9th and 10th intercostal arteries and extending into a left basilar density which had been demonstrated on a routine photofluorogram. This served to rule out neoplasm and aortic aneurysm, both of which had been considered in the differential diagnosis. Postoperative histologic study of the specimen confirmed the diagnosis of sequestration.

Two roentgenograms; 1 drawing.

SAUL SCHEFF, M.D.
Boston, Mass.

Pulmonary Adenomatosis. A. Fanconi. *Schweiz. med. Wchnschr.* 86: 408-412, April 21; 434-437, April 28, 1956. (In German) (Pathologischen Institut der Universität Zürich, Zürich, Switzerland)

The author reports a case of pulmonary adenomatosis (alveolar-cell carcinoma) and presents a complete discussion of this condition. In the material of the Pathologic Institute of the University of Zürich, 1927 to 1954, 9 cases were found in a total autopsy series numbering 42,922; 910 cases of primary bronchogenic carcinoma were encountered during the same time. At the Canton Hospital, St. Gall, 2 cases of adenomatosis were found among 10,877 autopsies, which yielded 185 cases of bronchogenic carcinoma. Upon the combined group of 11 cases, which includes the one reported here, the author bases his discussion. Only those cases of pulmonary adenomatosis which fulfilled the criteria of Swan (*Arch. Path.* 47: 517, June 1949) are considered: (1) proliferation of alveolar cells into high mucus-containing cylindrical epithelium; (2) absence of bronchogenic neoplasm; (3) absence of a primary extrapulmonary neoplasm.

The age range for the 11 cases was from thirty-three to eighty-three years; 7 of the patients were male.

The roentgen picture is characterized by areas of infiltration diffusely distributed throughout the lungs, with occasional cavity formation, as in the case reported. These findings are not in themselves diagnostic but must be considered in relation to the clinical picture; biopsy or autopsy confirmation is usually re-

quired. Tuberculosis, chronic bronchopneumonia, and pulmonary metastases are to be considered in the differential diagnosis. Treatment consists of lobectomy or pneumonectomy in the early stages of the disease; roentgen therapy has not been useful except in post-operative cases.

Clinically, the disease is marked by increasing dyspnea and mucous expectoration, with malaise, loss of weight, and anemia appearing as late symptoms. In the present series, duration of symptoms was from two months to three and one half-years, the average period being twelve months. Death is due to pulmonary complications, usually terminal bronchopneumonia.

The gross anatomic picture is produced by an extensive small nodular and at times diffuse pneumonic infiltration involving the lungs. Histologically, all cases show a high cylindrical epithelium in the alveolar walls, with the basic structure of the lung intact in most instances. This differentiates pulmonary adenomatosis from adenocarcinoma. Metastases were observed in 7 of the 11 reported cases. Distant metastases appear less commonly in adenomatosis than in bronchogenic carcinoma.

The author considers several theories regarding the origin and nature of pulmonary adenomatosis and advances his own hypothesis:

(1) Pulmonary adenomatosis is a primary tumor and is to be distinguished from metastatic lesions of adenocarcinoma of the bronchi or of disease in extrapulmonary organs.

(2) The origin of the tumor is either multicentric or unicentric, with elective metastases throughout the lung.

Three roentgenograms; 6 photomicrographs; 6 photographs; 1 diagram; 1 drawing.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

Massive Cystic Pulmonary Hamartoma. Report of Two Cases. Robert C. Jackson, John R. McDonald, and O. Theron Claggett. *J. Thoracic Surg.* 31: 504-510, April 1956. (Mayo Foundation, Rochester, Minn.)

Most pulmonary hamartomas are small, only about 5 examples over 5 cm. in diameter having been reported in the literature. Two additional cases of large pulmonary hamartoma resected at the Mayo Clinic are described.

The first patient was a 54-year-old woman with dyspnea for four years, temporarily relieved by thoracenteses yielding 1 to 1 1/2 quarts of reddish-brown fluid. Roentgenograms demonstrated a well defined opacity in the lower three-quarters of the left hemithorax, displacing the mediastinum. At surgery the mass ruptured, liberating 2,800 c.c. of fluid from a large central cavity. The operative specimen measured 17 × 15 × 12 cm. and weighed 600 gm. without its fluid contents. The patient died postoperatively, presumably of a cerebrovascular accident.

The second patient was a 27-year-old man. He had no symptoms but was known to have had a pulmonary cyst for eleven years. Roentgenograms showed a well circumscribed cystic lesion occupying much of the right lower lobe, containing considerable calcareous material. Thoracotomy disclosed a tumor replacing most of the right lower lobe, which was successfully resected. The surgical specimen measured 16 × 14 × 10 cm. and weighed 800 gm.

Abundant, partially calcified hyaline cartilage, fibrous connective tissue, and cystic spaces lined with epithelium were the characteristic histologic findings in these tumors. The second case showed, in addition, mature fat and bone, myxomatous tissue, smooth muscle, and mucosal glands, with areas strongly resembling normal bronchi.

Four roentgenograms; 3 photomicrographs; 3 photographs.

CAPT. GARTH R. DREWRY
U.S.A.F. Hospital, Tampa, Fla.

Unusual Roentgenologic Aspects of Pulmonary Metastases. P. Wellens. *J. belge de radiol.* 39: 339-343, 1956. (In French) (Centre anticancéreux de l'Université de Louvain, Louvain, Belgium)

Two very uncommon examples of multiple excavated pulmonary metastases are reported. The primary tumor in the first case was a carcinoma of the penis, in the second a bronchogenic neoplasm. The cell type was squamous in both cases. In a third case, multiple calcified pulmonary metastases appeared three years after amputation of the leg for osteosarcoma of the tibia.

Three roentgenograms. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Mass Surveys for Tuberculosis. P. S. Woodruff. *M. J. Australia* 1: 565-570, April 7, 1956. (Adelaide, Australia)

The results of compulsory chest x-ray surveys for tuberculosis over a three-year period in South Australia are presented. A total of 174,580 persons were examined and 124 new cases of tuberculosis were discovered. The number of cases in metropolitan areas, in towns with more than 5,000 population, and in towns with less than 5,000 population (including rural areas) is given, the incidence being highest in metropolitan areas. The occupational group most affected appeared to be that of housewives. Tuberculous lesions discovered as a result of mass surveys were generally less extensive than those found by other means; their prognosis in most instances was excellent. The mortality rate in patients observed from eighteen months to two years was 2 per cent; the total disability rate was 2 per cent.

Although most cases of tuberculosis in South Australia continue to be discovered in persons presenting chest symptoms and among persons known to have been exposed to the disease, the proportion of cases revealed by mass surveys has increased each year since compulsory surveys began. The ratio of new cases discovered in compulsory surveys in the author's community to registered cases is given as 1 to 4; the task of the x-ray survey organization is to discover this "unknown 20 per cent" of the tuberculous population.

One graph; 7 tables.

Mass Surveys for Pulmonary Tuberculosis. A. H. McNaughton. *M. J. Australia* 1: 570-572, April 7, 1956. (Melbourne, Australia)

At the time of this report the Division of X-Ray Surveys in Victoria (Australia) was taking 500,000 miniature films annually, as compared with 50,000 films made in 1947. The 35-millimeter film was used consistently for the initial reading, with a large film employed for follow-up investigation when tuberculosis was suspected. Between 1949 and 1954, the percentage of active or possibly active tuberculous lesions in Victoria dropped by more than two-thirds, and the per-

centage of the total number of tuberculous lesions by more than one-third. This is considered to be partially attributable to improved film-reading standards.

Among the services which the miniature chest survey should cover directly or indirectly are (1) the finding of disease, primarily of a tuberculous nature, and (2) where possible, the referral of patients with non-tuberculous abnormalities into appropriate channels for further investigation.

Apart from referral, the division did no follow-up work except in cases of carcinoma of the lung; in these instances an attempt was made to obtain confirmation of the presence of this condition. In 1953, 2 cases of lung cancer were discovered among every 10,000 miniature films; in 1954, this had increased to 2.5 cases in every 10,000.

The major problem in the conduct of mass surveys is the reading of both large and small films; it is believed that some primary instruction for film readers is warranted, particularly with respect to the close examination and comparison of all large films with their corresponding miniatures.

Four tables.

Some Aspects of Mass X-ray Surveys for Tuberculosis in New South Wales. Charles Rubinstein. M. J. Australia 1: 572-575, April 7, 1956. (Radiological Survey, Anti-Tuberculosis Association of New South Wales, Sydney, Australia)

The results of recent mass surveys for tuberculosis conducted in New South Wales are reported. The effectiveness of these surveys can be judged by the large number of cases of active disease discovered. A total of 1,333,796 x-ray films were taken by the Anti-Tuberculosis Association and the Department of Public Health in 1953 and 1954. Of all notifications of tuberculosis in the latter year, 43.19 per cent came from mass surveys.

In the city of Parramatta and in 19 municipalities in the Sydney metropolitan area, the number of persons radiologically examined was 620,739. An average of 2,585 films was taken per day on four mobile units. Six hundred and ninety-six persons with new active disease and 41 with a history of previous tuberculosis were found (0.1 per cent); 6,685 cases of inactive disease (1 per cent) and 2,060 cases (0.3 per cent) of non-tuberculous disease were detected.

Two graphs; 9 tables.

Pulmonary Tuberos Sclerosis. Report of a Case. André J. Bruwer, Robert R. Kierland, and Herbert W. Schmidt. Am. J. Roentgenol. 75: 748-750, April 1956. (A. J. B., Mayo Clinic and Mayo Foundation, Rochester, Minn.)

Pulmonary manifestations of tuberous sclerosis appear to have been recorded only 14 times. Pathologic study has shown multiple cysts of variable size in a relatively solid lung. When these are subpleural in location they may give rise to pneumothorax by rupturing. Walls of the cysts are made up of connective tissue with numerous blood vessels, but there is also a smooth muscle component with a cellular arrangement akin to that in myomas. Aside from the cystic change, there is the aspect of a diffuse myomatosis said to be related to genuine tumor formation.

The principal stigmata of tuberous sclerosis consist of mental deficiency, sebaceous adenomas, subungual fibromas, and intracranial calcification. In the pul-

monary form the intellect is usually normal, but the other signs are present. In addition, there are progressive dyspnea without cough, episodes of spontaneous pneumothorax (in about one-third of cases), and roentgenographic evidence of a coarse mottling of lung markings suggesting multiple cystic disease.

The authors present a case in a woman of forty-eight, illustrating the findings listed. There was no evidence of pneumothorax and no pathologic confirmation, but the pulmonary roentgenographic findings were typical and, with multiple sebaceous adenomas and subungual fibrosis, were felt to be diagnostic.

One roentgenogram; 1 photograph.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Chronic Pulmonary Infiltration with Eosinophilia in the Asthmatic. (Five Personal Observations, Including One with Histopathologic Analysis). J. Turiaf, P. Marland, and Y. Jeanjean. J. franç. de méd. et chir. thorac. 10: 353-379, 1956. (In French) (Hôpital Bichat, Paris, France)

The authors describe a complication of asthma consisting of chronic pulmonary infiltration and eosinophilia, as seen in 5 patients. This may appear at any time in the course of asthma, accompanied by poor general condition, subfebrile temperature oscillations, loss of weight, and increased sedimentation rate. Dyspnea may be present, sibilant râles are heard over the chest, hyperemia and other findings suggestive of local irritation are encountered on bronchoscopy, and there is a variable amount of mucous or mucopurulent expectoration containing eosinophils.

The roentgen appearance of the pulmonary infiltration is not specific. It may be unilateral or bilateral, involving only the middle lobe, the apical segment of the left lower lobe, or a peripheral or perihilar area, without segmental delimitation; it may even resemble scattered patches of bronchopneumonia. While the red blood count is unaltered, a leukocytosis appears, usually with a white count of less than 10,000, though it may exceed 20,000. The most typical finding is eosinophilia; in the 5 reported cases the count ranged from 18 to 54 per cent and persisted at high levels throughout the course of the disease, with simultaneous decrease in the number of circulating neutrophils.

In 1 of the authors' patients, the pulmonary lesion was inadvertently resected, and the histologic examination revealed the expected all-pervading eosinophilic infiltration. Also evident were bronchial dilatation and suppuration, areas of edematous and macrophagic alveolitis, systematized sclerosis, and especially vascular involvement, with predominance of a proliferating and stenosing endarteritis and periarteritis containing young histiocytes and eosinophils. While of similar allergic etiology and closely related to Löfller's pneumonia, the chronic eosinophilic pulmonary infiltration persists much longer, sometimes up to several years.

Knowledge of this entity is important, since antibiotic treatment, especially streptomycin, almost invariably aggravates the patient's condition. The prognosis in the cases reported in the last five years has been generally good; the process may at times disappear spontaneously after a few months, though in other instances the infiltration will clear only after prolonged therapy with ACTH and cortisone, which are considered specific remedies.

The differential diagnosis of inflammatory processes

of viral or bacterial origin, including tuberculosis, is facilitated by the absence of eosinophilia. In cases of Weingarten's "tropical eosinophilic lung," with adenopathy and splenomegaly, there is a history of residence in a warm climate. It is sometimes difficult to distinguish the allergic infiltration from bronchogenic carcinoma, since the roentgen appearance may be confusing and eosinophilia can be found in the presence of liver metastases; careful bronchoscopy and cytologic examinations of the bronchial secretions are advised. As a last resort, the authors recommend a therapeutic test, namely, administration of hormones (ACTH, cortisone) under antibiotic cover.

Eleven roentgenograms; 2 photomicrographs.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Interstitial Pneumonitis in Dermatomyositis. Edward S. Mills and William H. Mathews. *J.A.M.A.* 160: 1467-1470, April 28, 1956. (E. S. M., 66 Dorchester St., E., Montreal, Quebec)

Interstitial pulmonary infiltration as a cause of symptoms has frequently been noted in such collagen diseases as scleroderma, disseminated lupus, and polyarteritis, but has not heretofore been reported as a striking feature of dermatomyositis. The authors' case is thus unique in that the pulmonary symptoms and signs were a major feature from the onset of the illness. Roentgenograms revealed a non-specific interstitial infiltrate. Postmortem histologic examination showed the interalveolar and interstitial inflammatory cell infiltration as well as some evidence of attempts at healing by fibrosis.

Two roentgenograms; 4 photomicrographs.

SAUL SCHEFF, M.D.
Boston, Mass.

Coccidioidomycosis. A Review and Presentation of 100 Consecutively Hospitalized Patients. Denis J. O'Leary and Francis J. Curry. *Am. Rev. Tuberc.* 73: 501-518, April 1956. (D. J. O'L., 51 Madison Ave., New York 10, N. Y.)

This paper is based on a study of 100 patients with coccidioidomycosis consecutively hospitalized in the Fitzsimons Army Hospital from October 1948 to March 1955. Because it is an army hospital, males predominated, numbering 87. The ages ranged from eighteen to fifty-two years. Ninety-seven of the patients had been in at least one endemic area and 39 had been in more than one endemic region.

Symptoms were present in 83 patients, with cough reported by 70, chest pains by 40, and bleeding by 18. Less frequent symptoms were weight loss, malaise, fatigue, fever, headache, myalgia, dyspnea, and wheezing. Physical signs were observed in 28 patients, but in only 17 were these referable to pulmonary parenchymal lesions.

Roentgenographic abnormalities in the lungs were noted in all cases, though the commonly reported incidence of positive roentgen findings in hospitalized patients is only 80 per cent. The pulmonary lesions were bilateral in 6 patients and unilateral in the remainder. Cavitation was the predominant roentgen finding and occurred in 56 patients. The cavities were divided into thin- and thick-walled to determine the frequency of the classical thin-walled cavity: 33 were thin-walled (less than 3-mm. thick) and 26 were thick-walled.

The second most common roentgenographic lesion

was the nodule. Nodular lesions with central radiolucency were considered cavities, while those without central radiolucency were designated as true nodules. All of these nodules, when excised, were found to have soft necrotic centers, and considerable interchangeability was noted in some patients. The center of a nodule would slough to form a small, round, thick-walled cavity; then, if tension developed, this cavity would increase in size to become a large thin-walled cavity. In some instances the process would later reverse itself, with decrease in the size of the cavity and finally disappearance of central radiolucency and formation of a nodular residual similar to the nodules which remained constant throughout the observed course of the disease.

Pneumonic and infiltrative lesions occurred in 16 patients, varying from small hilar foci to large lesions occupying more than one-third of a lung. The tendency was for these lesions to resolve slowly, some lesions requiring two years for complete clearing.

Hilar and mediastinal adenopathy were found in 7 patients. This is a relatively low figure but tends to bear out the observation that adenopathy is an uncommon residual lesion, while in the acute phase of the disease it is much more common. Pleural effusion was found in 2 cases and bronchiectasis in 2, while a single patient developed middle lobe syndrome with atelectasis secondary to hilar adenopathy. Four patients were believed to have coexisting tuberculosis and 4 others had at least one positive smear for acid-fast bacilli, though tuberculosis was not felt to be proved.

Surgical removal of pulmonary disease was carried out on 62 patients. Only one major complication was encountered, the development of a new cavity post-operatively. The procedure varied with the type and extent of the disease, ranging from wedge resection to lobectomy.

Eight roentgenograms; 3 photomicrographs.

JOHN H. JUHL, M.D.
University of Wisconsin

Roentgen Aspects of Intrathoracic Blastomycosis. Chapin Hawley and Benjamin Felson. *Am. J. Roentgenol.* 75: 751-757, April 1956. (B. F., Cincinnati General Hospital, Cincinnati 29, Ohio)

North American blastomycosis is a chronic infectious disease caused by *Blastomyces dermatitidis*, manifesting suppurating granulomatous lesions of the skin and internal organs. Pulmonary involvement is common; diffuse milary lesions, homogeneous consolidation, solitary or nodular densities and abscesses of variable size, and fibrotic lesions have been demonstrated roentgenologically.

The authors reviewed the initial chest films in a series of 25 cases. In 5 cases these were normal. In the other patients there were diffuse milary nodulation, "fibrotic" infiltrations indistinguishable from those of chronic reinfection tuberculosis, homogeneous consolidations of segmental or subsegmental distribution, and tumor. The course of the disease was followed by serial roentgen study in 17 cases and was most commonly one of slow progression.

Of more significance for the diagnosis than the pulmonary findings is the disproportionate degree of pleural involvement, with frequent extrapleural extension and rib destruction, though similar changes are seen in metastatic neoplasm, tuberculosis, and other diseases.

The presence of a chronic undiagnosed pulmonary process, with or without associated granulomatous skin lesions, should lead to a search for *Blastomyces dermatitidis*.

Six roentgenograms; 1 table.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Pulmonary Nocardiosis. A Review with a Report of Seven Cases. D. H. Webster. *Am. Rev. Tuberc.* 73: 485-500, April 1956.

The most common of the forty-two species of *Nocardia* which have been recognized is *N. asteroides*, which was the etiologic agent in the 7 cases reported here. It produces a suppurative disease with a predilection for the lungs, brain, and subcutaneous tissues.

Nocardiosis is a rare disease, which may be acute or chronic. The symptoms and signs are those of an acute or chronic pneumonitis. The onset may be sudden or insidious; cough is common, and there is often production of greenish mucoid sputum, but hemoptysis is rare. In the cases reported here, the diagnosis was made by identification of the organism on sputum cultures.

Three of the author's patients showed roentgen changes suggestive of apical tuberculosis. Other roentgen findings in this group were those of pulmonary inflammatory disease simulating tuberculosis less closely. One patient had an abscess in the left lower lobe. In 2 others the lesion appeared to be an acute lobar pneumonia type of consolidation, in the right middle lobe and right upper lobe, respectively. The remaining patient had multiple bilateral upper lobe cavities resembling those of far advanced tuberculosis.

The author feels that in any case in which roentgenographic findings suggest pulmonary tuberculosis, nocardiosis should be suspected when bacteriologic confirmation of tuberculosis is lacking.

Five roentgenograms; 1 photograph; 1 photomicrograph.

JOHN H. JUHL, M.D.
University of Wisconsin

The Aspergilloma of the Lung. W. Höffken. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 84: 397-407, April 1956. (In German) (Bürgerhospital, Neumarkt, Köln, Germany)

Aspergillus infection of the lungs is usually a diffuse bronchopulmonary process with a tendency toward progression. In rare instances pulmonary aspergilloma presents a localized conglomeration of aspergillus fungi in a preformed cyst of the lung. The fungus ball, in these cases, is not pathogenic but acts as a saprophyte, and the lesion tends to remain stationary and asymptomatic for years.

Roentgenologically, the aspergilloma is seen as a round or ovoid area of increased density surrounded by a halo. This halo is best seen on tomograms in which the fungus ball appears to be floating. The outer wall is thin in contradistinction to thick-walled abscesses and tuberculous cavities. The contour of the outer wall is not smooth but tends to be slightly wavy. The condition has been observed almost exclusively in the upper lobes and predominantly on the right side.

Since the fungus is an aerobe, it is dependent upon a supply of oxygen. Therefore, a communication of the lesion with the bronchial tree is to be expected.

A case is reported in which the aspergilloma was located in the posterior segment of the right upper lobe.

With the aid of selective bronchography, the author was able to demonstrate a communication with the bronchial tree. He also succeeded in distending the cyst wall by injecting air *via* the bronchial catheter.

The condition was asymptomatic and remained stationary during a four-year period of observation. Lobectomy was finally performed, and the diagnosis of aspergilloma could be verified pathologically and bacteriologically. The cystic cavity contained amorphous fungous material, and the cyst wall was lined by ciliated epithelium and surrounded by muscle fibers and anthracotic material.

Six roentgenograms; 1 photograph; 5 photomicrographs.

ERNEST KRAFT, M.D.
Newington, Conn.

A Modification of the Routine Lateral View of the Chest to Permit Visualization of the Superior Mediastinum. Walter Lentino, Innocenzo Marchetto, and Maxwell H. Poppel. *Am. J. Roentgenol.* 75: 767-770, April 1956. (W. L., 2451 Webb Ave., New York 68, N. Y.)

Because of the inadequacy of the present routine lateral view of the chest, in which the shadows of the upraised arms obscure the superior mediastinum and the structures in that area, the authors recommend the following position: The patient assumes the erect lateral posture, placing his hands behind his back, where they are held from behind by an attendant, who clasps the heads of the humeri and rotates the shoulders backward and outward. This permits an excellent view of the superior mediastinum and the trachea and esophagus at that level. It has the disadvantages of discomfort for the patient and exposure of the attendant.

Four roentgenograms; 1 line drawing.

A. O. MILLER, M.D.
Louisville, Ky.

Mediastinal Pneumography. Harold J. Isard, Victor D. Bergelson, and Joseph Foreman. *Am. J. Roentgenol.* 75: 771-778, April 1956. (H. J. I., Albert Einstein Medical Center, Southern Division, 5th and Reed Sts., Philadelphia, Penna.)

During the course of routine presacral gas injection studies for the visualization of retroperitoneal structures, it was observed that sufficient gas often ascended through the diaphragm into the thorax to outline the thoracic aorta. The authors exploited this phenomenon for the study of mediastinal masses and other abnormalities.

One to one and one-half liters of oxygen is injected into the presacral space in the usual manner, after which the patient is instructed to walk about for fifteen minutes in order that the oxygen may diffuse upward into the mediastinum. Erect postero-anterior and lateral views of the chest are taken routinely and oblique projections added if necessary. Bucky technic is advantageous for the lateral and oblique exposures.

The authors have found pneumomediastinum useful in differentiating mediastinal tumors from aneurysm of the aorta. In addition, pericardial cysts, possibly some forms of congenital heart disease, coarctation of the aorta, and similar lesions may be studied by this method.

Thirteen roentgenograms; 2 drawings.

A. O. MILLER, M.D.
Louisville, Ky.

Bi-Axial Roentgenkymography: An Aid in Differential Diagnosis of Solid Mediastinal Tumor and Aneurysm. Martin Schneider and Jorge Ceballos. *Am. J. Roentgenol.* 75: 785-795, April 1956. (M. S., University of Texas, Medical Branch, Galveston, Texas)

The authors describe a technic whereby they have obtained roentgenkymograms using first a grid with horizontal slits and then, with the patient in the same position, a grid with vertical slits. It appeared to them that the essential difference between the expansile pulsation of a vascular mass and the transmitted pulsation of a solid mass lay in the inability of the transmitted pulsation to occur in more than one direction at any one time. An aneurysm should show pulsations horizontally and vertically at its margins simultaneously. Expansion and contraction should be demonstrable in any other chosen planes. A solid mass, however, should exhibit its transmitted pulsations in one direction only. It was felt therefore that if two kymograms were made, one with the grid slits horizontal, the other with the slits vertical, expansile vascular wave forms would be seen in both films, but transmitted pulsations would be shown in only one of the two film records. The position in which the mass in question will be best shown against the adjacent radiant lung field is chosen by fluoroscopy and is used thereafter for the kymographic studies. The authors report 6 cases in which this method proved of aid in differentiating between thoracic aneurysm and a solid mediastinal tumor.

Eleven roentgenograms; 12 roentgenkymograms; 1 photograph.

A. O. MILLER, M.D.
Louisville, Ky.

Mediastinal Tumors and Cysts. N. Ringertz and S. O. Lidholm. *J. Thoracic Surg.* 31: 458-487, April 1956. (Sabbatsberg Hospital, Stockholm, Sweden)

This is a survey of 155 pathologically verified primary mediastinal tumors and cysts seen at Sabbatsberg Hospital during the period 1944 to 1954. Sixty-one per cent of the cases (68 per cent of the benign and 23 per cent of the malignant lesions) were discovered by routine mass radiography. The location, gross anatomy, histology, age and sex distribution, and clinical course are recorded for each type of tumor and cyst, the material being too extensive for abstracting.

Among the tumors are two types apparently previously unreported. Three tumors histologically resembled a bronchial adenoma but were not connected with the lung or bronchial tree. These may represent teratomas with a one-sided development. Two large multicystic tumors in the posterior mediastinum, included in the group of bronchial cysts, had a structure resembling embryonal lung tissue.

Three roentgenograms; 17 photomicrographs; 2 drawings; 1 graph; 4 tables.

CAPT. GARTH R. DREWRY
U.S.A.F. Hospital, Tampa, Fla.

THE CARDIOVASCULAR SYSTEM

Displacements of the Barium-Filled Esophagus by Cardiovascular Lesions. Nathaniel E. Reich and David E. Ehrlich. *Dis. of Chest* 29: 376-387, April 1956. (N. E. R., 135 Eastern Parkway, Brooklyn 17, N. Y.)

Because of the close anatomic relationship of the

esophagus to the heart and aorta, many cardiovascular diseases can be diagnosed by a careful roentgenologic and fluoroscopic esophageal examination. Normally there are indentations of the anterior wall of the esophagus by the aortic arch, the pulmonary artery and large bronchi. Lower down, the esophagus is in contact with the left auricle.

The following cardiovascular abnormalities can be recognized by study of the barium-filled esophagus in appropriate projections.

(a) *Anomalous right subclavian artery:* This aberrant vessel arises from the left side of the aortic arch or from the left subclavian, crosses to the right, usually behind the esophagus at the level of D-3 or, rarely, in front of the esophagus or trachea. Roentgenograms show an oblique indentation at the level of D-3, above the aortic arch.

(b) *Right aortic arch:* The aorta arises normally, ascends towards the right, courses toward the left behind the esophagus, and continues downward slightly to the right of the normal position. The roentgenogram reveals compression of the esophagus from the right and posteriorly, with displacement to the left and forward at the level of D-3 or 4.

(c) *Right aortic arch with left descending aorta:* The descending portion of the aorta crosses behind the esophagus, displacing it anteriorly.

(d) *Right descending aorta:* This anomaly is usually found with a right aortic arch, but may be present with a left aortic arch. The descending aorta descends downward to the right of the vertebral column. The roentgenogram shows slight deviation of the esophagus to the left at the level of the aortic arch in the postero-anterior view, and no displacement in the right anterior oblique.

(e) *Double aortic arch:* A vascular ring encircles and compresses the trachea and esophagus, causing dysphagia and esophageal dilatation. The roentgenogram shows bilateral constriction of the esophagus.

(f) *Truncus arteriosus:* The esophagus is indented along its left margin and displaced posteriorly.

(g) *Dextrocardia:* With dextrocardia there is an indentation on the right margin of the esophagus by the right aortic arch.

Rheumatic cardiac lesions may also be recognized by chamber enlargement: In (a) *mitral stenosis*, the enlarged left auricle compresses the mid portion of the esophagus posteriorly and to the right, occasionally to the left. (b) *Mitral regurgitation* results in enlargement of the left auricle and may produce esophageal displacement.

Aortic aneurysms will compress and displace the esophagus, depending upon their size and origin. Since syphilitic aortitis results in elongation, tortuosity and dilatation of the aorta, the esophagus is displaced to the left below the aortic arch. Aneurysms of the left carotid or subclavian arteries, if they become large enough, may produce compression above the level of the aortic arch. Esophageal changes are also observed with *dissecting aneurysms*.

The aorta becomes tortuous and elongated with *atherosclerosis*. Because of the close anatomical association of the esophagus, it may be displaced.

Eighteen roentgenograms; 1 drawing.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Radiology of the Lung in Left Heart Failure. D. S. Short. *Brit. Heart J.* 18: 233-240, April 1956. (The London Hospital, London, England)

Ninety-three radiographic examinations in a series of 51 patients with left heart failure or left ventricular enlargement form the basis of this study. Patients with lung disease and those with mitral valve lesions were excluded from the analysis.

The films were reviewed with special attention to hilar clouding, pulmonary clouding, hydrothorax, interlobar septal thickening, interlobular (septal or Kerley's) lines, and venous distention. Hilar clouding was the commonest abnormality (61 times), causing hazing of the outline of the pulmonary artery or bronchus. Pleural involvement in the form of widening of the lung fissures or hydrothorax was observed 51 times, the latter varying from a thin layer to frank effusion.

Pulmonary clouding, consisting of hazing of ribs, heart borders, and vessels, was seen 40 times. Septal or, as the author prefers, interlobular lines were seen 20 times, while pulmonary venous distention was clearly identified only 8 times.

Comparing the picture of left heart failure with congestion resulting from mitral stenosis there are two important differences. In mitral stenosis the lung changes are persistent and progressive, while in left heart failure they are usually transient. In mitral stenosis hydrothorax is less common and is apt to be unilateral; in left heart failure it is common and generally bilateral. Hemosiderosis is seen only in mitral stenosis, not in left heart failure. Enlargement of the pulmonary artery is apt to be greater in mitral stenosis than in left heart failure. Recognition of these differences might be quite helpful in deciding which was the dominant valve lesion in a patient in failure with both mitral and aortic disease.

Seven roentgenograms; 1 drawing.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Dextroposition of the Heart Simulating Congenital Dextrocardia. Werner J. Hollendonner and Bernard H. Pastor. *Am. J. Med.* 20: 647-650, April 1956. (Medical Service, VA Hospital, Philadelphia, Penna.)

A case of marked cardiac displacement due to eventration of the diaphragm, with the roentgen appearance of dextrocardia, is presented. Displacement of the heart (dextroposition) may simulate congenital dextrocardia or incomplete rotation of the heart (dextroversion). Differentiation of these conditions, although difficult, may be of considerable clinical importance. True congenital dextrocardia can be identified by means of the pathognomonic electrocardiographic pattern. Congenital dextroversion may be difficult to differentiate from dextroposition except by identification of the factor or factors producing the cardiac displacement.

Five figures, including 1 roentgenogram.

THEODORE E. KEATS, M.D.
University of Missouri

Pericardial Effusion in Generalized Scleroderma. Jay I. Meltzer. *Am. J. Med.* 20: 638-642, April 1956. (Department of Medicine, College of Physicians & Surgeons, New York, N. Y.)

Two cases of generalized scleroderma with extensive pericardial effusion diagnosed antemortem are reported.

The pericarditis associated with scleroderma may have a protracted course and may not significantly con-

tribute to disability over long periods of time. The fluid obtained from the pericardium in the author's cases was characterized by high protein, low cell count, absence of blood, and negative culture.

It is to be borne in mind that sclerodermatous involvement of the myocardium may occur and produce cardiac dilatation with roentgen findings which may simulate pericardial effusion.

Four roentgenograms; 1 electrophoresis pattern.

THEODORE E. KEATS, M.D.
University of Missouri

The Persistent Ostium Primum Atrial Septal Defect. S. Gilbert Blount, Jr., Oscar J. Balchum, and Goffredo Gensini. *Circulation* 13: 499-509, April 1956. (University of Colorado, Denver, Colo.)

The ostium primum type of atrial septal defect was established either by surgical inspection or autopsy in 5 of a group of 85 patients under study for atrial septal defects. Analysis of the 5 cases indicates that a differential diagnosis can at times be made between the ostium primum and ostium secundum type of defect.

Embryologically the ostium primum defect is a failure of union between the septum primum and the fused atrioventricular cushions. The defect is usually large and is often associated with malformations of the mitral and tricuspid valves. At times there is also a defect of the upper portion of the ventricular septum. The clinical findings which seem to differentiate the septum primum defect from the septum secundum defect are: (1) earlier onset of symptoms, (2) larger heart, (3) physical findings suggestive of mitral insufficiency, (4) left ventricular enlargement and left axis deviation, demonstrated electrocardiographically, (5) low position of the intracardiac catheter as it crosses into the left atrium, and (6) easier catheterization of the left ventricle. The location of the defect is probably not the significant feature in producing the clinical picture, but the deformity of the valves producing mitral insufficiency is considered to be the basis of the differential diagnosis.

Five roentgenograms; 2 photographs; 3 electrocardiograms; 1 table. RICHARD F. McCLURE, M.D.
Redondo Beach, Calif.

Congenital Aneurysm of the Superior Vena Cava. G. H. Lawrence and T. H. Burford. *J. Thoracic Surg.* 31: 327-328, March 1956. (600 S. Kingshighway Blvd., St. Louis 10, Mo.)

The authors report the successful surgical excision of a spontaneous or congenital aneurysm of the superior vena cava, with no evidence of recurrence eighteen months later.

A 52-year-old housewife complained of pain along the thoracic vertebrae of two years duration, associated with increasing exertional dyspnea. There was no history of trauma or surgery. Roentgenograms and fluoroscopy showed a mass in the right superior mediastinum with minimum pulsation. At operation, needle aspiration yielded venous blood and the true nature of the aneurysm was determined on dissection. The aneurysm had a 2-mm. stalk at its origin, which was immediately above the junction of the azygos vein and superior vena cava.

Two previously reported cases are cited.

One roentgenogram; 1 photograph.

GRACE E. LINDSAY, M.D.
Cleveland City Hospital

Roentgen Examination of the Inferior Vena Cava in Retroperitoneal Expanding Processes. C. G. Helander and A. Lindbom. *Acta radiol.* 45: 289-297, April 1956. (Roentgendiagnostic Department, Karolinska Sjukhuset, Stockholm, Sweden)

The authors report the results of venography of the inferior vena cava in 55 cases. The contrast material was injected through polyethylene catheters which were introduced percutaneously into both common iliac veins. Unilateral injection often proves sufficient, but a more complete filling of the vena cava was obtained when the injection was made on both sides.

While the patient was performing the Valsalva maneuver, 25 c.c. of sodium acetate 20 per cent was injected under pressure. An exposure was made at the end of the injection and followed by another not more than two seconds later. A simple cassette changer manually operated, was employed.

The normal appearance of the vessel is described. Deformity of the vena cava due to an expanding lesion was present in 16 cases. Retroperitoneal lymph node enlargement, (malignant lymphoma and metastases from uterine cancer), as well as other tumors in the vicinity of the inferior vena cava, may be detected and localized by the method.

Sixteen roentgenograms; 1 table.

THEODORE E. KEATS, M.D.
University of Missouri

Calcification of the Aorta as an Aid to the Diagnosis of Syphilis. J. Sydney McCann and D. C. Porter. *Brit. M. J.* 1: 826-827, April 14, 1956. (Royal Victoria Hospital, Belfast, Ireland)

Cardiovascular syphilis characteristically affects the aortic valve, the aortic bulb, and the lower ascending aorta. This predisposes to atheromatous changes, and in about one-third of cases deposition of calcium occurs.

Since serological reaction is positive in only 70 to 80 per cent of cases of cardiovascular syphilis, the roentgen demonstration of calcification in the ascending aorta is a distinct aid in diagnosis. The authors reviewed 19 cases in which it was noted. Nine of the patients gave cardiac symptoms such as dyspnea on exertion and angina. Seven had negative blood Wassermann reactions, and in 8 the cerebrospinal fluid was negative. Four showed associated aneurysmal widening of the aorta. In 5 cases, the serology remained positive even after treatment.

In view of the limitations of other diagnostic tests, and the fairly high specificity of this sign, it seems fitting that its usefulness be again brought to mind.

Six roentgenograms; 2 tables.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Outcome of Uncomplicated Syphilitic Aortitis. R. E. Irvine. *Brit. M. J.* 1: 832-834, April 14, 1956. (Newcastle General Hospital, Newcastle, England)

Conflicting estimates of the prognosis in asymptomatic syphilitic aortitis led to the study reported here.

On routine cardiologic examination of 1,330 known syphilitics, 61 cases of uncomplicated aortitis were found. The age range for this group was from thirty-six years upward; the duration of infection, where this was known, was from thirteen to thirty-seven years. Diagnosis was based upon the fluoroscopic demonstration of aortic dilatation or upon the presence of calcification in the walls of the ascending aorta.

The patients were followed from three to fourteen years (average 5.1 years), and in this time no definite effect upon life expectancy was demonstrated. Neither age, sex, occupation, presence of absence of symptoms, amount of treatment, or duration of the disease appeared to influence the prognosis. In almost 30 per cent of the patients some increase in the amount of aortic dilatation occurred, and in a few aortic valvular incompetence developed. This was seen especially in the cases with more advanced degrees of aortic dilatation.

The incidence of deterioration in this group is apparently higher than in other previously reported series. The author attributes this to more strict selection and closer appraisal of cases.

Two graphs.
DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Total Anomalous Pulmonary Return. An Analysis of Thirty Cases. Vincent L. Gott, Richard G. Lester, C. Walton Lillehei, and Richard L. Varco. *Circulation* 13: 543-552, April 1956. (University of Minnesota Hospitals, Minneapolis, Minn.)

Thirty cases of total anomalous pulmonary venous return have been collected and analyzed. Twenty-six of these cases were proved by direct vision either at operation or at the autopsy table. The diagnosis in the remaining 4 cases was established after thorough clinical evaluation. Many anomalous pathways of return are possible, but the three most common are via the "persistent left superior vena cava," into the coronary sinus, and directly into the right atrium. In all cases not having associated major cardiac defects, the right side of the heart was hypertrophied and the left side of the heart was atrophied.

With complete pulmonary venous drainage into the right atrium, a right-to-left shunt is necessary for life. Before birth, both the ductus arteriosus and foramen ovale perform this function. After delivery, in the majority of cases, a patent foramen ovale or a larger atrial septal defect is the sole avenue for venous filling of the left side of the heart. In all 7 autopsied cases in which there were no major associated defects, the foramen ovale was open to some extent.

Clinical findings characteristic of this anomaly are: mild cyanosis, systolic murmur in the left second or third interspace, right axis deviation and right ventricular hypertrophy on electrocardiographic examination, and increased oxygen saturation of the right atrial blood to a degree equal to or higher than that of the systemic arterial blood. Roentgen examination reveals hyper-vascularity of the lungs in all cases. Two characteristic appearances are noted: (1) In those cases having drainage via the "persistent left superior vena cava," the heart and mediastinum formed a "figure of eight" because of the dilated superior vena cava and so-called left superior vena cava. (2) In 12 cases the heart, as seen in the postero-anterior view, had a box-like appearance, with an almost horizontal take-off of the left cardiac border immediately below the aortic arch. Angiocardiographically there is opacification of a very large right atrium, followed immediately by filling of a small left atrium. The pulmonary artery is abnormally large and opacifies simultaneously with the hypoplastic aorta.

Seven roentgenograms; 6 figures; 2 tables.

RICHARD F. MCCLURE, M.D.
Redondo Beach, Calif.

Congenital Anomalies of the Large Mediastinal Vessels. Franco Chiariotti and Carlo Picchio. *Radiol. med. (Milan)* 42: 321-344, April 1956. (In Italian) (Ospedale di Circolo di Busto Arsizio, Busto Arsizio, Italy)

Seven cases of vascular anomalies in the mediastinum were studied roentgenographically. Six patients did not present any signs or symptoms referable to the cardiovascular system, and the anomaly was discovered on routine chest films, with or without barium studies of the esophagus, and on tomograms of the mediastinum and trachea. The seventh patient had obvious clinical manifestations of aortic coarctation. The authors believe that in most cases no special angiocardigraphic studies are necessary if the examiner is aware of the roentgenographic appearance presented by the main varieties of vascular malformations. Visualization of the esophagus and stratigraphic studies are the most useful roentgenographic procedures. When other "acquired" vascular alterations exist, such as a tortuous and dilated aorta, the diagnosis may be more difficult.

The presence of a right aortic arch was the most common anomaly observed by the authors; 1 instance of double aortic arch was also encountered.

The article contains a very interesting critical discussion of the embryology of the branchial arches with a clear anatomical presentation of these vascular anomalies based on the classification of Heim de Balsac (1954).

Twenty-four roentgenograms; 12 drawings.

R. G. OLIVETTI, M.D.
Newington, Conn.

Pelvic Phlebography Obtained by Transosseous Injection of Contrast Material. A. Rabaiotti. *Ann. di radiol. diag.* 29: 18-29, 1956. (In Italian) (Istituto di Radiologia e del Radium dell'Università e degli Ospedali Riuniti, Parma, Italy)

Injection of contrast material into a vein of the foot gives poor visualization of the veins of the pelvis. Injection into the spongiosa of the calcaneus is more satisfactory, and even better results are obtained by injection into the saphenous vein or directly into the femoral vein. With all these methods, however, visualization of the deep venous plexus of the pelvis is poor, as the contrast material tends to follow the shortest route. If the deep circulation is to be outlined, several avenues of approach are available: the dorsal vein of the penis or clitoris, the uterovaginal plexus, or the uterine vessels. All these approaches, however, have obvious disadvantages. Transosseous injection has the advantage that the site of injection may be varied to demonstrate the part of the plexus of deep veins that is of particular interest.

If the horizontal ramus of the pubis is injected, the retropubic, suprapubic, and obturator veins are visualized, as well as the collaterals of the major main vessels. Often both sides are demonstrated. If the iliac crest is utilized, iliac branches of the iliohumbar vein and of the superior gluteal vein are shown. Both the common iliac and the hypogastric are frequently seen. With injection of the greater trochanter, one constantly sees the common femoral vein, the external and common iliac, and the hypogastric system by way of the gluteal and sciatic veins.

The author uses a sternal puncture needle and injects 20 c.c. of the contrast medium within five to ten seconds, under general anesthesia. The time may be

prolonged if there are signs of stasis. A better, more informative study can be obtained if both sides are injected simultaneously.

The transosseous method is indicated (a) when an immediate diagnosis is needed; (b) when one wants to know the extent of an occlusion; (c) when, with patent main vessels, one wishes to obtain a picture of the deep venous plexus; (d) when the femoral vein is occluded in the inguinal region and incision of the skin for injection of the lesser saphenous vein is contraindicated.

Five roentgenograms.

ALEXANDER R. MARGULIS, M.D.
University of Minnesota

THE DIGESTIVE SYSTEM

Radiology of the Pharyngo-esophageal Region; Plummer-Vinson Syndrome. Victorino D'Alotto. *Acta radiol. Interamericana* 5: 80-87, July-August-September 1955. (In Spanish) (J. E. Uriburu 1267, Buenos Aires, Argentina)

This paper is based on the observation of 10 cases in which membranous bands occurred in the pharyngo-esophageal area. Eight patients were women over the age of forty, with Plummer-Vinson syndrome (dysphagia and anemia). In 4 of these a single membrane was present; in 1 there were two membranes, while 3 showed a tubular stenosis. Two patients were males. One of these had scleroderma, with a membrane in the pharyngo-esophageal area and tubular narrowing in the rest of the esophagus. It is of interest that the radiologic pictures of Plummer-Vinson syndrome of long standing and scleroderma are at times very similar.

Twenty-eight roentgenograms.

JAMES T. CASE, M.D.
Santa Barbara, Calif.

Definition, Distribution, and Roentgenologic Aspects of Esophageal Diverticula. Brombart. *J. belge de radiol.* 39: 362-376, 1956. (In French) (Bruxelles, Belgium)

The esophageal diverticulum is a circumscribed, centrifugal expansion, constant in location but varying in size, shape, and orientation in space as a result both of its elasticity and of peristalsis. These characteristics serve as an aid in differentiation from false diverticula and especially from tertiary contractions. The appearance, moreover, must be reproducible on successive films for a diagnosis.

In a series of 350 cases of esophageal diverticula seen over an eight-year period, the distribution was as follows: posterior aspect of the pharyngo-esophageal junction (Zenker type), 38 cases (10.8 per cent); supra-aortic segment of the thoracic esophagus, 10 (2.8 per cent); middle third of the thoracic esophagus (aortic, inter-aortic-bronchial, interbronchial, and retrocardiac segments), 259 (74 per cent); epiphrenic segment, 33 (9.4 per cent); juxtacardiac region, 11 (3 per cent).

Zenker's diverticulum, always located on the posterior mid-line, is best seen in a straight lateral view. The inter-aortic-bronchial diverticulum, which is of the pulsion type, originates from a triangular space bordered by the aortic arch, the descending aorta, and the left main bronchus; it always appears on the left antero-lateral wall of the esophagus and is therefore best seen in the right anterior oblique projection. The inter-bronchial diverticulum, by far the most frequent,

emerges from the right anterolateral wall of the esophagus, between the two main bronchi. The frequency of calcified lymph nodes in this neighborhood suggests "traction" as a pathogenetic factor. Interbronchial diverticula are best visualized in a left anterior oblique position. The epiphrenic diverticulum may achieve considerable size, producing compression symptoms. It is said to be found frequently in association with hiatus hernia and, because it appears in relatively young persons, may be of congenital origin.

Fourteen roentgenograms. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Frequency of the Asymptomatic Lower Esophageal Contractile Ring. Philip Kramer. New England J. Med. 254: 692-694, April 12, 1956. (Boston University School of Medicine, Boston, Mass.)

Occasionally a ring-like constriction around the lower end of the esophagus, ranging in width from 2 to 6 mm. and lying some 2 to 6 cm. above the cardioesophageal junction, may be demonstrated. The diagnosis of this unusual ring, be it a contractile structure or a herniated esophagogastric junction, depends on its radiographic demonstration, since it has not been seen at esophagoscopy.

One hundred patients without esophageal symptoms were examined with a view to determining the incidence of these rings in the absence of symptoms. The majority of the series were examined in the horizontal right anterior oblique position but some were studied also in the left anterior oblique position. A regular barium-tap water mixture was used, such as is employed in routine gastrointestinal study.

Six patients were shown to have asymptomatic contractile rings, 5 occurring in males ranging from twenty-five to seventy-two years of age and the sixth in a woman of sixty-three.

The author points out that presence of a ring is not sufficient to explain dysphagia unless this symptom is reproduced when a barium-food bolus or barium capsule can be shown to be arrested at this level. The greater the degree of narrowing the more likely are symptoms to appear. These include chronic intermittent dysphagia of years duration, with sharply localized sub-sternal distress lasting for varying periods of time. During a moderate attack the patient may try liquids to propel the food downward, but during a severe attack total abstinence is the rule.

Four roentgenograms; 1 table.

SAUL SCHEFF, M.D.
Boston, Mass.

Roentgenologically Demonstrable Gastric Abnormalities in Cases of Previous Congenital Pyloric Stenosis. O. Steinicke Nielsen and M. Roelsgaard. Acta radiol. 45: 273-282, April 1956. (Copenhagen County Hospital, Gentofte, Denmark)

The authors report the results of roentgen examination of 45 adults with a previous history of congenital pyloric stenosis, medically treated. In 35 (78 per cent) there were characteristic changes in the prepyloric part of the stomach. No corresponding changes were revealed in a control group of 45 unselected patients. In addition, the examinations revealed peptic ulceration in 14 of the pyloric stenosis cases against only 2 in the control group. This confirms previous impressions that the incidence of peptic ulcer is higher among adults who have been treated medically for congenital pyloric

stenosis. Furthermore, it was seen that in 35 out of the 45 cases with a history of pyloric stenosis the distal 2 or 3 cm. of the prepyloric region of the stomach presented permanent narrowing with an abrupt transition to the adjoining portion of the antrum. Similar abnormalities were not observed in the controls.

The authors are of the opinion that the gastric abnormalities demonstrated in cases previously treated medically for congenital pyloric stenosis generally persist into maturity. Such changes are independent of possible symptoms. Finally, in a series of 30 duodenal ulcer cases without a history of congenital pyloric stenosis, narrowing of the prepyloric area was found in only 2, suggesting that, when a roentgenographic examination of the stomach reveals permanent narrowing of the prepyloric region, congenital pyloric stenosis should be suspected.

Twenty-four roentgenograms; 1 graph; 3 tables.

THEODORE E. KEATS, M.D.
University of Missouri

Roentgenological Diagnosis of Hyperrugosity of the Stomach. Robert S. Sherman and Daniel Wilner. Cancer 8: 1206-1217, November-December 1955. (R. S. S., Department of X-Ray Diagnosis, Memorial Center, New York, N. Y.)

Hyperrugosity of the stomach is a harmless variant, characterized by large but otherwise normal mucosal folds. Roentgenologically, it is identified by the presence of one or more rugae 1 cm. or greater in width. The condition may be generalized, localized to one area of the stomach, or involve only a single ruga. The large folds have sharp, smooth, distinct edges. Very often they can be traced directly into the neighboring mucosa by a gradual diminution in size. This direct continuity with an obviously normal fold is particularly helpful in identifying single-fold hyperrugosity. In localized hyperrugosity, the lesion sometimes presents a distinct border, with no evidence of a gradual transition into the normal surrounding mucosa. Because of the large size of the rugae, their course usually differs from normal, being more tortuous. This pattern, however, is not fixed but will change to a degree approaching that seen under normal conditions. The vermiform arrangement encountered in the resting stomach may be readily altered by compression, so that, while the appearance is never entirely normal because the large folds will not become completely effaced, a rearrangement that is related to the direction of the pressure force applied to the stomach is apparent. For instance, with peristalsis, a shifting and moving of the large rugae take place so that the folds are aligned the same way that normal folds would be, i.e., transverse to the wave; after the passage of the peristalsis, they return to their previous tortuous or resting configuration. While hyperrugosity may be demonstrated on moving-grid table-top films, good documentation of fold characteristics by fluoroscopy and spot-films adds much. When dealing with the upper portion of the stomach, the effects of distention, either by gas (providing double contrast) or by the barium mixture, and of external pressure effects related to respiration and different body positions, must be carefully appraised and fully utilized.

When the stomach is nearly empty, the folds appear larger; with increasing distention they become somewhat smaller and fewer in number, though the commonly applied degrees of distention generally will not

cause their effacement. The sharp, straight, or angular channels of barium, which may be held between giant rugae and can resemble the outline of irregular tumefactions, will disappear as folds become separated and more completely outlined. Another helpful point in evaluating these bizarre streaks of barium, which sometimes can even appear as a deep ulceration, is the fact that they never extend beyond the stomach margin. In judging fold size, care must be exercised not to mistake several adjacent folds for a large single one because they have not been separated by adequate amounts of barium or by sufficient palpation.

Of almost equal importance to the positive points mentioned above for the roentgen diagnosis of hyper-rugosity is the absence of any accompanying abnormality. The size and configuration of the stomach are not altered nor its capacity or distensibility. No mass can be felt in association with the stomach defect nor is there any functional disturbance traceable to hyper-rugosity. There is no pylorospasm nor any other form of spastic phenomenon, no hypersecretion, alteration in emptying time, hyper- or hypoperistalsis, or gastric retention.

In the differential diagnosis, polyposis as well as certain forms of cancer and gastritis must be considered. Recognition of hyper-rugosity is obviously desirable to avoid an unfavorable prognosis and unnecessary operation. Gastroscopy and repeated roentgen examinations should lead to the correct diagnosis without undue risk to the patient but, if the least doubt exists, a biopsy should be performed. In the authors' experience the majority of patients with hyper-rugosity have no symptoms.

Histologically there was no significant infiltration or specific abnormality in 10 cases studied pathologically in a routine fashion.

Six illustrative cases are reported.

Fifteen roentgenograms; 3 photographs.

The Roentgenogram in Perforated Peptic Ulcer.

Lawrence S. Mann, Israel E. Kirsh, Jesse Eisen, and John E. Familiaro. *Arch. Surg.* 72: 450-455, March 1956. (L. S. M., VA Hospital, Hines, Ill.)

Of 157 cases of perforated peptic ulcer studied by the authors, 152 were proved at surgery and 5 at necropsy. Most perforations were anterior duodenal. With the single film technic and the patient upright, a positive diagnosis was made in 13 of 17 cases (76.5 per cent). When 3 additional views were obtained—right and left lateral decubitus and supine lateral—the diagnostic accuracy rose to 85 per cent. The left lateral decubitus view has the advantage of demonstrating free air between the right border of the liver and the lateral abdominal wall without danger of confusion with gas shadows within the fundus or splenic flexure. In the lateral supine view the free air is demonstrable under the anterior abdominal wall, where it must be differentiated from intragastric air. In 2 cases this was the only position in which the diagnosis of pneumoperitoneum could be made.

Other x-ray signs of interest appeared during this study. In 6 cases air was trapped in the hepatorenal space. Some of the cases showed air within the psoas sheath which did not change with alterations in position. In one of these there was extension of gas into the mediastinum. Occasionally the inner and outer walls of the bowel were demonstrated (Rigler's sign) by the intraperitoneal air.

In 27 patients free intraperitoneal fluid with overlying free air was visualized in the upright position. In 54 cases there was evidence of ileus. Among this group 18 showed distention of the small intestine but not of the large bowel. Fluid levels were seen in the small intestine in 20 cases. The data are of interest in connection with the radiological differentiation between organic obstruction of the small bowel and paralytic ileus. They established that distended loops of small bowel with fluid levels do not necessarily mean small-bowel obstruction, for none of these patients had obstruction. The paralytic ileus can be readily explained by the peritonitis.

Seven roentgenograms; 1 table.

SAUL SCHEFF, M.D.
Boston, Mass.

Hepatic Cirrhosis and Gastro-Duodenal Ulcer. E. de Arzúa Zulaica. *Rev. clin. españ.* 56: 410-414, March 31, 1955. (In Spanish) (Bilboa, Spain)

In 1949, the author presented a case of perforated duodenal ulcer with cirrhosis, which was demonstrated by biopsy. Here he reports a case of gastric ulcer with hepatic atrophic cirrhosis.

A review of the work of previous investigators shows the incidence of simultaneously occurring cirrhosis and peptic ulcer to vary widely. Although some workers regard the association as coincidental, in the author's opinion, some relationship between the two processes is probable. He suggests the performance of gastrointestinal studies on all patients with clinical evidence of hepatic cirrhosis, and of chemical tests of liver function in cases of peptic ulcer.

Five roentgenograms; 1 photograph; 2 photomicrographs.

FABIO SALCEDO, M.D.
St. Vincent's Hospital, N. Y.

Cancer of the Gastric Stump. E. de Arzúa Zulaica. *Rev. clin. españ.* 60: 389-393, March 31, 1956. (In Spanish) (Bilboa, Spain)

The author reports a study of primary carcinoma occurring at the level of the remaining gastric pouch following subtotal gastrectomy. Lesions developing at the site of the anastomosis are not included. The operations were performed at least five years previously for a benign process.

Clinically, the important characteristics of the condition are: (1) latency of symptoms unless the tumor has invaded the cardia or has metastasized; because of this, the prognosis is poor; (2) in general, rapid growth of the lesion; (3) pain, of variable type; (4) hemorrhage, especially melena; (5) anemia, similar to that due to iron or protein deficiency, rarely megaloblastic; (6) later onset of symptoms than in benign processes.

For roentgen examination, the positions of choice are the postero-anterior and the right anterior oblique. The examination is begun with a thin barium swallow, followed by thick barium, and is concluded with an air-contrast study. Laminagrams at the time of the latter are helpful in doubtful cases. Gastroscopy is of little value and involves the risk of perforation. The possible usefulness of cytologic examination by means of the Cabré Fiol method is suggested, although the author has not employed it.

A case is presented of cancer of the gastric stump in a forty-nine-year-old patient who had been operated on for duodenal ulcer twenty-three years previously.

Death occurred a few months after the diagnosis was established, following palliative surgery.

Five roentgenograms. FABIO SALCEDO, M.D.
St. Vincent's Hospital, N. Y.

Pharmacoradiography of the Stomach. J. Pfeiffer. Fortschr. a. d. Geb. d. Röntgenstrahlen 84: 421-428, April 1956. (In German) (Poetenweg 5, Leipzig-N 22, Germany)

In cases where no definite conclusions can be reached on the basis of ordinary barium examination of the stomach, including mucosal studies, re-investigation with morphine medication is recommended. This procedure has proved especially valuable in pyloric stenosis, since morphine tends to increase gastric tonicity and peristalsis and dilates the duodenum so that secondary stasis ensues in the bulb.

The fasting patient receives a hypodermic injection of 0.01 gm. of morphine hydrochloride. Three to five minutes later the usual barium mixture is ingested, after which the patient is placed in a horizontal position. (In the erect posture, the morphine reaction is either less pronounced or completely absent.) The morphine effect appears after eight minutes and wears off after fifteen to twenty minutes. In fresh ulcer cases, with recent hemorrhage, the use of morphine is contraindicated.

This method has been found especially helpful in pyloric stenosis and gastric hypersecretion and for recognition of rigid segments of the gastric wall. It has enabled the author to differentiate between stenosing antral gastritis and neoplasm with increased accuracy. In pyloric obstruction he has almost invariably been able to demonstrate either an underlying ulcer or a tumor.

Five examples illustrate the application and advantages of the morphine technic. These include duodenal ulcers, stenosing carcinoma of the gastric antrum, healing antral gastritis, and a normal borderline condition.

Seventeen roentgenograms. ERNEST KRAFT, M.D.
Newington, Conn.

Effects of Artificial Gaseous Distension of Stomach and its Role in Making the Liver Radiologically Visible. N. R. Konar, D. C. Roy Chaudhury, and R. Roy Chaudhury. J. Indian M. A. 26: 257-262, April 1, 1956. (Nilratan Sircar Medical College, Calcutta, India)

In an investigation of the effects of artificial gaseous distention of the stomach, the authors discovered that, with the introduction of 1,500 to 2,000 c.c. of air, the liver could be clearly outlined radiologically. The opaque liver was visible in sharp contrast to the air-filled stomach, and its size could be determined. Comparison of a control film of the liver taken by simple radiography with one made following artificial distention demonstrates the superiority of the latter method.

The liver was clearly visualized in 10 of 24 cases studied; in 8, the lower border of the organ was partially seen. In the 6 remaining patients, no improvement over plain films of the abdomen was evident. In no instance was demonstration of the liver after gastric distention inferior to that on a plain film.

A sense of upper abdominal distention was experienced by all patients following the introduction of measured quantities of air through a Ryle's tube; other symptoms were nausea, eructation of gas, and passage of flatus. In general, symptoms were more pronounced

in patients suffering from cirrhosis of the liver, emphysema of the lungs, different types of heart disease, anemia, or hepatosplenomegaly.

Six roentgenograms; 1 table.

Transverse Colon in a Right Inguinal Hernia with a Confusing Distortion of the Stomach. Ralph V. Gieselman, George A. Collodi, and Urie A. Parkhill. Gastroenterology 30: 690-693, April 1956. (R. V. G., VA Hospital, St. Louis, Mo.)

A case of herniation of the transverse colon into an inguinal hernia is presented. An accompanying and related distortion and displacement of the stomach caused by traction on the gastrocolic ligament gave rise to a radiographic picture that was suggestive of a retrogastric mass. Surgical repair of the hernia restored both stomach and colon to their normal positions.

Five roentgenograms. ALVIN SEGEL, M.D.
Cleveland City Hospital

Volvulus of the Cecum and Sigmoid Colon. An Analysis of Nine Cases. Thomas G. Nelson and Warner F. Bowers. Arch. Surg. 72: 469-478, March 1956. (T. G. N., Brooke Army Hospital, Fort Sam Houston, Texas)

Volvulus of the large bowel most commonly involves the sigmoid, less commonly the cecum, and rarely the transverse colon. Early recognition and prompt treatment are imperative because of the high rate of recurrence and the inherent danger of strangulation with its attendant complications.

The two essentials for the development of volvulus are a loosely attached, redundant bowel and a point of fixation for torsion. In volvulus of the cecum, obstruction may occur when the bowel doubles upon itself along either an oblique or a transverse axis or when torsion along a longitudinal axis occurs. In sigmoid volvulus, the usual mechanism consists in distention of the distal, or rectal, limb of the loop, which progresses upward and comes to cross anterior to the proximal, or colonic limb.

Familiarity with the gas patterns of small and large bowel distention and an awareness of the patterns that often occur with volvulus of the colon lead to the diagnosis on the plain film of the abdomen. In cecal volvulus the involved loop usually migrates to the left upper or upper central abdomen and presents marked distention with a single fluid level in the upright position. If a separate stomach bubble is not seen and the appearance is suggestive of gastric dilatation, aspiration will quickly resolve the problem. Distended loops of small bowel may appear below or to the right side of the displaced cecum. The remainder of the colon will contain minimal amounts of gas or none at all. Occasionally a twisting at the site of torsion will be noted on the plain film but this feature is oftener seen in sigmoid volvulus.

In sigmoid volvulus there appears a distended segment of large bowel with a more definite loop formation than is seen in cecal volvulus. The apex of the loop lies most frequently in the upper or mid abdomen, the convexity to the right. There is an absence of gas in the left lower abdomen. The proximal bowel may be seen superimposed on the shadow of the involved loop. If strangulation supervenes, fluid levels within the peritoneum and separating the loops of bowel will become apparent.

In the case of torsion of the cecum, barium contrast will demonstrate a cone-shaped obstruction with spiral mucosal folds at the point of obstruction, the barium

usually failing to pass into the cecum. Between acute attacks, the barium will enter the cecum, the latter showing unusual mobility and length, extending into the pelvis. Contrast study of sigmoid volvulus will reveal classic "ace-of-spades" or "bird's-beak" patterns. Rarely, the barium will pass this obstruction by a valve-type mechanism which allows its entry but not its return.

Surgical correction, consisting of fixation in cecal volvulus and resection in sigmoid volvulus, is the treatment of choice.

Four roentgenograms; 10 drawings; 1 table.

SAUL SCHEFF, M.D.
Boston, Mass.

Intussusception in Children and Adults. Collective Review. Marshall J. Orloff. *Internat. Abst. Surg.* 102: 313-329, in *Surg., Gynec. & Obst.*, April 1956. (Hospital of the University of Pennsylvania, Philadelphia, Penna.)

Intussusception is the invagination of a segment of the gastrointestinal tube into an adjacent segment. It has been known to occur everywhere from the stomach to the anus. From 90 to 95 per cent of all cases are in children, in whom it is the most frequent cause of intestinal obstruction. In adults, it is both an infrequent and puzzling disease.

The present paper, as the title indicates, is a review of the literature covering both of these age groups. The bibliography of 67 references reveals its scope.

Four roentgenograms; 3 drawings; 14 tables.

Intussusception as a Cause of "Disappearing" Carcinoma of the Rectum. Harvey J. Dworken. *Gastroenterology* 30: 694-697, April 1956. (2460 Fairmount Blvd., Cleveland 6, Ohio)

Rectal prolapse of a carcinoma of the sigmoid is described in a woman in the first trimester of pregnancy. The lesion was originally believed to be primary in the rectum, but after barium-enema examination and repeated sigmoidoscopic studies its true source was determined. It is suggested that perineal relaxation consequent to pregnancy may have been of importance in causing the intussusception.

One roentgenogram.

ALVIN SEGEL, MD.
Cleveland City Hospital

The Value of the Lateral View of the Rectosigmoid. G. Osborne, J. N. Pattinson, and M. W. P. Ward. *J. Fac. Radiologists* 7: 286-290, April 1956. (The Middlesex Hospital, London, England).

An analysis of the relative value of lateral and oblique views of the rectosigmoid in 100 barium-enema studies is reported. In 51 cases an appreciable length of sigmoid could be shown on the lateral view which was not visible on the oblique. Four cases of carcinoma were demonstrated on lateral projections which were not apparent on the oblique.

It is concluded that, in addition to routine right anterior oblique views, a lateral view should be made in every barium-enema examination.

Ten roentgenograms. DON E. MATTHIEN, M.D.
Phoenix, Ariz.

Spontaneous Pneumoperitoneum in the Newborn. Report of a Case. Arnold Porter. *New England J. Med.* 254: 694-696, April 12, 1956. (454 Angell St., Providence 6, R. I.)

Following uneventful delivery by cesarean section, a

two-day-old male infant was explored because of developing dyspnea, cyanosis, abdominal tenderness and distention, with absence of audible peristalsis. X-ray studies showed a large amount of free air beneath the diaphragm and a normal distribution of intestinal gas, without evidence of obstruction. At operation, free air escaped from the peritoneum, but careful search of the gastrointestinal tract, from the esophagogastric junction to the rectum at the level of the pelvic floor, revealed no evidence of perforation, nor was there any sign of an intra-uterine meconium peritonitis. No satisfactory explanation is available for this or for 2 similar cases in the literature (Birdsong and Frame: *West Virginia M. J.* 47: 173, 1951. *Abst. in Radiology* 59: 609, 1952) showing the spontaneous presence of gas in the abdomen.

Pneumoperitoneum in the newborn is usually accompanied by intestinal obstruction and perforation proximal to the block and is associated with atresia or stenosis of the bowel, meconium ileus, mid-gut volvulus, strangulated hernia, or more rarely mesenteric thrombosis, perforated peptic or bacterial ulcer, ruptured diverticula, and perforation secondary to trauma.

Since spontaneous pneumoperitoneum is so rare and the above noted causes relatively frequent, the author believes that exploration should be carried out once free air is demonstrated roentgenologically under the diaphragm.

Two roentgenograms.

SAUL SCHEFF, M.D.
Boston, Mass.

Pneumostratigraphy in the Investigation of the Left Lobe of the Liver. P. Bétoulières, P. Carabalona, M. Pélissier, and J. Candon. *J. belge de radiol.* 39: 453-485, 1956. (In French) (Service de Radiologie des Hôpitaux de Montpellier, Montpellier, France)

A "functional" syndrome of the upper abdomen, or an epigastric mass, could originate in any of several organs, as for example the left lobe of the liver, abdominal esophagus, stomach, spleen, pancreas, kidneys, suprarenals, aorta, vena cava, or lymph nodes. In most such instances, the information provided by conventional roentgenograms, even after a barium meal and enema, is incomplete. Additional knowledge can be obtained from body-section roentgenography, following diagnostic pneumoperitoneum and/or retroperitoneum, with or without gastric and/or colonic insufflation. Technical details of this procedure are presented, including descriptions of anatomical and pathological appearances, which, however, exceed the scope of an abstract. Those interested in the procedure will find the paper helpful, particularly for its illustrations, which are accompanied by explanatory line drawings.

The authors believe that in experienced hands, and with trained observers, the method can help (1) to determine the origin of an abdominal mass (even though barium studies have failed to achieve this goal) when surgical removal is contemplated; (2) to predict the extent of possible excision of a malignant tumor by delineating its adhesion to neighboring organs; (3) to confirm or exclude, in patients with "epigastric symptomatology," the existence of organic lesions, permitting earlier surgery under more favorable circumstances and avoiding useless operations in late cases.

Sixteen roentgenograms; 15 drawings.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Comparison of Rapid Intravenously and Orally Administered Contrast Mediums for Routine Gall-Bladder Study. V. Kremens, S. M. Berger, and E. M. Cohn. *New England J. Med.* 254: 705-706, April 12, 1956. (V. K., Hahnemann Medical College, Philadelphia, Penna.)

The authors used both oral and intravenous cholecystography to study 68 consecutive non-jaundiced patients in whom disease of the biliary tract was clinically suspected. Six tablets (3.0 gm.) of iopanoic acid (Telepaque) and 20 c.c. of 40 per cent sodium iodipamide (Cholografin) were the doses used orally and intravenously, respectively. When the intravenous study was made immediately following the determination of non-visualization by the oral route, re-examination at least a week later was performed to exclude the chance of an additive effect.

In 24 of the 68 patients, or 35.3 per cent, adequate gallbladder visualization was obtained with Telepaque. Stones were noted in 10. When these same 68 patients were examined with the intravenous medium, 39 gallbladders, or 57.4 per cent, were visualized, and in 23 of these stones were demonstrated. Thus, in a significant number of cases, non-opaque calculi were discovered in gallbladders classified as non-functioning after oral cholecystography.

For routine use, the advantages of the oral route are many: the reactions are fewer and less severe, the patient and the radiologist are spared time, the tablets are easily administered, and the procedure is less costly. In properly selected non-jaundiced patients, however, with a diagnosis of a non-functioning or dysfunctioning gallbladder after oral examination, the intravenous use of Cholografin provides a non-surgical visualization in a high percentage of cases.

One table.

SAUL SCHEFF, M.D.
Boston, Mass.

Internal Biliary Fistulas. Oriol Arango and Augusto Marmolejo. *Acta radiol. Interamericana* 5: 43-62, July-August-September 1955. (In Spanish) (Calle 56 n° 41-57, Medellín, Colombia)

The authors report their experience with internal biliary fistulas in the city of Medellín, Colombia. Their series includes 17 thoroughly investigated cases; in only 1 of these was the diagnosis in doubt, and it is possible that the symptoms in this instance were due to incompetence of the sphincter of Oddi. Generally these fistulas occur between the biliary tree and a neighboring portion of the digestive tract, but they may communicate with the bronchial tree, the pericardium, the urinary bladder, the uterus, the vagina, ovarian cysts, renal pelvis, or portal vein. Communications between the duodenum and gallbladder are most common.

An historical review and a discussion of the etiology pathology, and clinical diagnosis are followed by a consideration of visualization of the abnormal biliary tract. The radiologic differential diagnosis should include extrahepatic vascular shadows, the shadow of the border of the psoas, bronchovascular arborizations projected in the hepatic area, infrahepatic abscess, abnormal hepatic flexure of the colon, duodenal diverticulum, Frostberg's sign consisting of spontaneous opacification of the ampulla of Vater, lipomatosis, and a gaseous shadow in the biliary tree.

Fifteen roentgenograms; 5 tables.

JAMES T. CASE, M.D.
Santa Barbara, Calif.

The Bile Ducts of Cholecystectomized Patients With and Without Dyskinesia Before and After Morphine Injection. A Preliminary Report. Eric Gunnarson. *Acta radiol.* 45: 298-304, April 1956. (Roentgen Diagnostic Department, University Clinics, Lund, Sweden)

If one excludes patients with residual stones or other mechanical obstruction of the common bile duct, there still remains a certain group having post-cholecystectomy biliary symptoms. Recurrent pain is the principal complaint, and this is believed to be caused by spasm of the sphincter of Oddi. In the differentiation of a hypertonic sphincter from a small stone lodged in the papilla of Vater, it was thought that observation of the width of the common duct might be helpful.

Intravenous Biligrafin studies were performed in 54 cholecystectomized patients. Administration of morphine in this group caused sphincter spasm sufficient to prevent emptying of the duct and to cause pain in a number of patients, particularly in those who had post-operative symptoms prior to the examination. There was an average increase of width in the common duct of 24 per cent after morphine. The widening was slight or not demonstrable in the symptomless patients.

No mention is made of the duct width or appearance in the presence of mechanical obstruction or residual stones.

Eight roentgenograms; 1 table.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Operative Cholangiography. Survey of 83 Cases in 232 Cholecystectomies. Royal A. Weir and Carlos Lizama. *Missouri Med.* 53: 280-284, April 1956. (Missouri Pacific Employees' Hospital, St. Louis, Mo.)

The authors base their study of operative cholangiography on 83 cases from a series of 232 cholecystectomies performed between 1953 and early 1955. The number of operative cholangiographic examinations undertaken in that period has increased from 2.5 per cent of the total number of cases for 1953 to 95.3 per cent in 1955, with an operative mortality of 0.8 per cent (2 cases); morbidity was minimal. In 52 cases the common duct was explored, with removal of seventeen stones in 1 instance. In 4 of the 52 cases, stones retained from previous common duct explorations were found; in 5 cases, the control cholangiogram through the T-tube showed that stones were being left behind in common duct explorations.

Two technics for the performance of operative cholangiography are described, neither of which requires any special instrumentation. The first consists of direct injection of 30 per cent Urokon into the common duct by means of an angled needle devised by the authors from a regular No. 22 hypodermic needle. In the second method, a ureteral catheter or polyethylene tube is employed. The advantages and disadvantages of each of these procedures are summarized.

It is suggested that operative cholangiography be performed as a routine procedure in biliary surgery, with a control cholangiogram obtained through a T-tube following common duct exploration; additional cholangiograms should be taken between ten and twelve days after surgery, before removal of the T-tube.

The importance of accuracy and precision in the performance of operative cholangiography is stressed, and it is urged that the surgical team be familiarized with at least one of the two technics described.

Two drawings; 4 tables.

Cholecystography During Lactation. Kaj H: son Holmdahl. *Acta radiol.* **45**: 305-307, April 1956. (Roentgen Department, University Hospital, Uppsala, Sweden)

Oral cholecystography with Telepaque was performed in 11 lactating mothers. Ten other lactating patients were similarly examined with Bilijodon (a Telepaque-type preparation) as the contrast medium.

The post-partum state evidently did not influence gallbladder visualization adversely. Iodine was found to be present in the breast milk in greatest amounts at about eighteen hours after oral ingestion, but the infants fed on this milk showed no reactions to the medium. The act of suckling the infant did not cause contraction or emptying of the gallbladder.

Examinations making use of Telepaque-type preparations during lactation are apparently safe and reliable.

Two diagrams; 1 table.

DON E. MATTHIASEN, M.D.
Phoenix, Ariz.

On the Visualization of the Renal Pelves in Cholegraphy. Georg Theander. *Acta radiol.* **45**: 283-288, April 1956. (Roentgen Department, Malmö Allmänna Sjukhus, University of Lund, Lund, Sweden)

An analysis of the results of 452 unselected cholegraphic studies after the injection of commercial Biligradin or a lithium salt of Biligradin provides no support for the belief that visualization of the renal pelves in cholegraphy is suggestive of hepatobiliary disease.

Visualization of the renal pelves occurred in 264 (58 per cent) of the 452 examinations. In 65 cases cholegraphy was performed in the presence of jaundice, but comparison of this group with the remainder of the series showed that jaundice did not influence the frequency or duration of demonstration of the renal pelves.

In the choice between the disodium and lithium salts of Biligradin, preference should be given to the latter; although it fills the renal pelves more frequently, the visualization is often of short duration and therefore of minor importance and more than outweighed by lowered toxicity and by the higher frequency with which the biliary system is satisfactorily demonstrated.

One roentgenogram; 2 graphs.

THEODORE E. KEATS, M.D.
University of Missouri

THE MUSCULOSKELETAL SYSTEM

Fibrous Dysplasia of Bone: Analysis of 15 Cases of Surgically Verified Costal Fibrous Dysplasia. James F. Zimmer, David C. Dahlin, David G. Pugh, and O. Theron Clagett. *J. Thoracic Surg.* **31**: 488-496, April 1956. (Mayo Foundation, Rochester, Minn.)

About one-third of the benign costal tumors reported in the literature are diagnosed as fibrous dysplasia. The condition may be monostotic or polyostotic. Any bone may be affected.

Among surgically treated cases of costal tumors at the Mayo Clinic, 15 examples of fibrous dysplasia were found, 3 of polyostotic type, 12 apparently monostotic. The patients ranged in age from eighteen to sixty-five years. Seven of the cases were asymptomatic and were discovered only on roentgenography. Eight patients had had varying degrees of discomfort for from one week to fifty years.

The characteristic x-ray appearance was of a radio-

lucent lesion (frequently of a fuzzy, patchy density), sharply demarcated from the normal bone, expanding the rib, with a thin but intact cortex. Frequently there were corrugations on the inner surface of the cortex which appeared as septa. Cystic areas were present in 6 cases. Another manifestation of fibrous dysplasia, not found in this surgical series because the patients are rarely operated on, is moderate expansion of a long segment of rib with a uniform ground-glass appearance so that cortex and spongiosa cannot be distinguished.

Since malignant change has been seldom observed, costal lesions in the polyostotic type of fibrous dysplasia rarely require treatment. When a single lesion is present, or a limited number, the diagnosis may be uncertain without pathologic study. In such cases total excision is indicated, if possible.

Three roentgenograms; 2 photographs; 2 photomicrographs.

CAPT. GARTH R. DREWRY
U.S.A.F. Hospital, Tampa, Fla.

Progressive Diaphysal Dysplasia (Englemann's Disease). H. B. Stewart and E. R. Cole. *J. Pediat.* **48**: 482-485, April 1956. (H. B. S., 311 Cobb Bldg., Sacramento, Calif.)

Englemann's disease is described as consisting in a symmetrical, fusiform, sclerotic expansion of the cortex of the shafts of the long bones, occurring usually in children. The sclerosis encroaches on the medullary cavity but has no trabecular architecture suggestive of normal bone formation. The metaphyses and epiphyses are spared, with an abrupt change from the normal to the dense structure of the shaft. The femora, humeri, shins, forearms, clavicles, and base of the skull are involved in about that order of frequency.

The disease must be differentiated from infantile cortical hyperostosis, which occurs in infants and most commonly involves the ribs and mandible and is accompanied by constitutional symptoms with local signs of swelling and periosteal reaction. Osteopetrosis begins in the metaphysis, is hereditary, and involves both membranous and enchondral bone.

Twelve cases of Englemann's disease have been reported in the literature. The author presents a detailed report of a thirteenth acceptable instance, demonstrating the progressive nature of the sclerosis.

Five roentgenograms.

SAUL SCHEFF, M.D.
Boston, Mass.

Muscular Dystrophy. II. Radiologic Findings in Relation to Severity of Disease. B. Girdany and T. S. Danowski. *J. Dis. Child.* **91**: 339-345, April 1956. (Children's Hospital, Pittsburgh, Penna.)

This report is part of a symposium covering many aspects of muscular dystrophy. Radiologic findings in reasonably complete skeletal surveys of 31 children are tabulated and graded. An attempt was made to correlate severity of disease with the degree of change demonstrated on the roentgenograms.

In the spine the most common abnormality was scoliosis, which occurred to a more severe degree in those children with more extensive muscular involvement. Lordosis, when it occurred, was usually compensatory and was unrelated to the stage of the muscular disease. A few of the patients showed so-called "caninization," characterized by an apparent increased height of vertebral bodies as compared with their widths. Long bones tended to show over-tubulation or over-constriction, with more marked changes in the most severely crippled

limbs. Osteoporosis was often associated. Films of some muscles showed feathery, mottled radiolucencies indicative of fatty infiltration in fairly close correlation with the degree of muscle weakness. Actual increase in muscle mass was limited to cases with the pseudohypertrophic form of the disease and was most frequently seen in the calves. Findings in the skull, heart, lungs, and bones of the forearm were generally within the normal range. Bone age was slightly retarded or normal.

In the authors' opinion none of these radiographic changes are pathognomonic of muscular dystrophy and can all be explained on the basis of prolonged disuse and immobilization. The only exception is increased muscle mass with fatty infiltration seen in the pseudohypertrophic form of the disease.

[The radiographic reproductions are of poor quality and do not demonstrate the authors' points well.—J. W. B.]

Ten roentgenograms; 1 graph; 1 table.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Osseous Metastasis of Thyroid Origin. A. K. Datta Gupta. *J. Indian M. A.* 26: 264-269, April 1, 1956. (Medical College, Calcutta, India)

A case of osseous metastases of thyroid origin in a twenty-seven-year-old man is reported. At first admission, a swelling, which had been increasing gradually, was evident on the lateral surface of the upper end of the right tibia; a small, firm nodule in the right lobe of the thyroid gland, stationary in size and symptomless, was also observed. The bone swelling was diagnosed clinically and radiologically as an osteoclastoma of the upper and outer part of the right tibia. Four months later, a roentgenogram showed bony changes in the upper end of the tibia which were strongly suggestive of osteogenic sarcoma. X-ray study of the lung at that time disclosed no evidence of metastasis. The thyroid nodule had undergone no enlargement. The report of a biopsy, performed prior to amputation of the right leg, was descriptive of an adenocarcinomatous metastatic process, with the thyroid nodule considered to be the primary growth. Microscopic study of the nodule following right hemithyroidectomy, with removal of adjacent lymph nodes, confirmed this diagnosis.

Subsequent to amputation, roentgenograms of the skull revealed a circular worm-eaten area of destruction in the left parietal bone. X-ray study of the left knee showed evidence of secondary deposits in the lower end of the femur and upper end of the fibula. Palliative deep x-ray therapy could not be arranged, and the patient died about a year after the first admission.

The author found no previous recorded instance of thyroid metastases in the tibia and fibula. A review of the literature is included.

Four roentgenograms; 2 photomicrographs; 1 photograph.

Bone Changes in Tropical Ulcer. J. Scott Brown and J. H. Middlemiss. *Brit. J. Radiol.* 29: 213-217, April 1956. (J. H. M., United Bristol Hospitals, Bristol, England)

Tropical ulcer, an important cause of morbidity in tropical Africa, has been extensively discussed in the literature, but the radiological manifestations have received little attention. The authors classify the roent-

gen changes in the bone as primary and secondary. The former are inflammatory, consisting of a periostitis sometimes extending to produce cortical sequestration, and commonly causing a considerable heaping up of new subperiosteal bone to produce an ulcer "osteoma." The secondary changes consist of medullary osteoporosis, deformities due to effect on growth of altered gait and contractures, and occasional malignant degeneration. Osteomyelitis is rarely seen, although frequently the base of the ulcer consists of exposed bone.

Twenty-two roentgenograms; 3 photographs.

JAMES NICHOLS, M.D.
Cleveland City Hospital

Herniated Lumbar Intervertebral Disks. An Eight-Year Survey. Carlo Scuderi. *Am. J. Surg.* 91: 481-483, April 1956. (104 S. Michigan Blvd., Chicago 3, Ill.)

This report is based upon 115 disk operations on 113 patients followed over a period of six months to eight years. The author, recognizing some difference of opinion regarding the value of myelography, is nevertheless strongly in favor of this procedure in selected disk cases. It usually affords precise localization of the lesion, with resultant saving in operating time and decreased risk to the patient; multiple herniated disks can be demonstrated, and the surgeon forewarned; the presence of a spinal tumor can usually be detected. In the series reported, the diagnostic accuracy of myelography was close to 90 per cent. In only about 5 per cent were the findings negative in cases of herniation proved at operation. False positive myelographic findings were of practically the same incidence.

The indications for spinal fusion following disk removal are discussed. The author would limit the procedure to cases falling into the following categories: (1) hemilaminectomy or total laminectomy performed in removal of the disk; (2) spondylolisthesis; (3) spina bifida; (4) sacralization of a transverse process with evidence of a false joint; (5) marked bony osteophytes in the area; (6) pronounced sclerosis of the adjoining bony surfaces; (7) a loose, unstable fifth lumbar vertebra.

The results are described as excellent or good in about 80 per cent of the series.

Eight tables.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Accessory Bones of the Intervertebral Disks and Spondylosis Deformans. G. Teichert. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 84: 457-462, April 1956. (In German) (Röntgenabteilung des Hafenkrankenhauses, Hamburg, Germany)

Accessory or interposed bones are frequently observed between vertebral bodies anteriorly and, less often, laterally. These bones are to be differentiated from calcifications in the fibrous ring of disks; the former usually show osseous structures, while the latter are amorphous. The accessory bone cannot be confused with avulsion fracture of a vertebral body or of an osteophyte, or with a persistent center of ossification, since the sharp corner of the adjacent body always remains intact.

Development of the accessory bone is slow. Its growth can be followed from pinhead size to the width of a disk, with the bone finally assuming a triangular shape, with the apex pointing toward the disk.

Since accessory bones are often seen in association

with osteospondylitis, a causal relationship has usually been assumed. That the simultaneous occurrence is observed mostly in the older age group would suggest, however, that it is merely coincidental; moreover, osteospondylitis may be absent altogether, especially in younger persons, even when a large accessory bone is present. Occasionally, an accessory bone can give rise to localized tipping of contiguous vertebral bodies, particularly in the cervical and thoracic areas.

The bone formation is generally believed to be due to the growth of vascular fibrous tissue into a degenerated disk. In the present study, however, the accessory bones are likened to similar formations found in higher animals, as well as in primitive reptiles, where they are known as intercentral and hypochondral spurs. In view of the embryology of vertebrates, the author considers accessory bones to be true skeletal elements. Although nothing definite is known about their genesis, knowledge of their asymptomatic nature is important, especially in medicolegal cases.

Nine roentgenograms.

ERNEST KRAFT, M.D.
Newington, Conn.

Posterior Dislocation of the Shoulder. Sylvester J. O'Connor and Albert S. Jacknow. *Arch. Surg.* 72: 479-491, March 1956. (S. J. O'C., University of Michigan Medical School, Ann Arbor, Mich.)

Accurate diagnosis and adequate treatment of posterior dislocations of the shoulder are essential if limitation of motion and pain are to be avoided. Of the 17 cases of posterior dislocation (in 16 patients) reported in this paper, 8 were misdiagnosed at the first examination. Ten occurred following trauma; 7 were the result of shock therapy or of grand mal seizures. In 12 there were associated fractures of the proximal humerus, and in 7 of these the dislocation was overlooked at the initial examination.

In most instances it is necessary to have axillary, oblique, or transthoracic views of the shoulder to establish the displacement of the humerus. Diagnostic features include exposure of the inferior third of the glenoid and rotation of the lesser tuberosity so that it is seen on end in the anteroposterior view. The authors have noted, also, a cystic or hollow appearance of the humeral head on the anteroposterior film. Less commonly, overlapping of the glenoid and humeral head are seen. In the transthoracic view there is an interruption of the scapulohumeral arch formed by the axillary scapular margin and the neck and shaft of the humerus.

The injury to the humerus may be only an indentation on the anterior head, where it has been impressed by the glenoid. More often there is fracture of at least one of the tuberosities, the head, neck, or upper shaft. Rarely, the glenoid rim is avulsed.

When a fracture of the head or neck of the humerus is seen, one should satisfy himself that there is no associated dislocation by obtaining appropriate views. Both closed and open reduction are useful.

Twenty-seven roentgenograms; 7 photographs; 1 table.

SAUL SCHEFF, M.D.
Boston, Mass.

Arthrography of the Shoulder as a Diagnostic Aid in Tendon Injuries. Graham A. Kernwein, William R. Sneed, Jr., Bertil Roseberg, and Francis G. Zeier. *Am. J. Surg.* 91: 654-657, April 1956. (G. A. K., 303 N. Main St., Rockford, Ill.)

Precise determination of the cause of a painful, dis-

abled shoulder is frequently difficult or impossible on the basis of physical and clinical findings. Tendinitis, capsulitis, tendon injuries, bursitis, and various other conditions may closely mimic one another. The authors have used arthrography for differentiating tears and ruptures of the rotator cuff mechanism from other causes of shoulder pain. Such injuries are frequently amenable to surgical therapy, once a precise diagnosis has been made.

Arthrography is reserved for selected patients, usually those with symptoms over a considerable period of time, who have received little or no benefit from conservative therapy. Initial plain films of the shoulder are always obtained. Following anesthesia of the skin just lateral to the coracoid process, a long needle is introduced into the joint space under fluoroscopic observation and 20 to 30 c.c. of 35 per cent Diodrast mixed with an equal volume of distilled water is injected. After manipulation of the shoulder, phototimed spot-films are obtained in anteroposterior projection, in internal and external rotation.

Normally the arthrogram will demonstrate filling and bulging of the joint capsule and an outline of the subscapular bursa. No contrast material will escape into the subacromial bursa unless there has been a tear or rupture of the rotator cuff mechanism. The contrast material disappears from the joint within a few hours and no immediate or delayed adverse effects have been encountered.

Thirty-two of 72 arthrographic studies showed indications of rotator cuff tear as manifested by filling of the subacromial bursa. In 23 patients operated upon, the diagnosis was confirmed. The remaining patients had continuing symptoms and disability.

Three roentgenograms. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Fractures of the Triquetrum. Noel F. Bartone and R. Vincent Grieco. *J. Bone & Joint Surg.* 38-A: 353-356, April 1956. (N. F. B., 20 Fifth Ave., New York 11, N. Y.)

Fractures of the triquetrum are said to be the second most common carpal fracture, but in 2,500 roentgenographic examinations of wrists, over a four-year period, only 46 examples were found, which demonstrates the infrequency of this type of injury.

Triquetral fracture in this series was most often produced by a fall on the hand with forcible palmar flexion or violent dorsiflexion. The injury was also found as the result of a direct blow to the carpus and of sudden resistance against twisting motions of the wrist.

No specific signs or symptoms were observed which would differentiate this type of fracture, and the diagnosis was dependent upon radiography. Two major types were noted: (1) fractures involving the dorsal aspect of the bone, in the nature of chip, flake, traction, or avulsion fragments, best seen on an oblique view; (2) linear, fissure, or comminuted fractures through the body of the triquetrum, requiring fine-detail postero-anterior, lateral, and oblique views for demonstration.

In 70 per cent of the authors' cases the fracture was limited to the triquetrum; in the remainder there were also fractures of adjacent bony structures. Treatment varied from partial immobilization for two to six weeks in the clinically mild cases to complete immobilization for four to six weeks in the more severe cases. The chip fractures frequently did not unite, and a permanent ossicle was often formed. No major complications of

healing were observed, and it appeared that aseptic necrosis does not occur as the result of this type of injury.

One figure, 2 tables. ROBERT B. CONNOR, M.D.
Parkland Memorial Hospital, Dallas, Texas

Tomographic Studies on the Normal and Injured Knee. Stig Fagerberg. Acta radiol. Suppl. 138, 1956. (Roentgen Department, University Hospital, Uppsala, Sweden)

This monograph, translated from the Swedish, describes the author's experience at Uppsala in the use of body-section radiography to supplement standard radiography and arthrography of the knee. His films were obtained with a unidirectional-motion apparatus called the *Danatome*.

Unsharpness is inherent in tomography, for various reasons. Blurring because of effects of parallax, for example, is proportional to the amplitude of motion used, and also to the thickness of the film and the thickness of the effective layers of the intensifying screens. A compromise must always be reached between the factors affecting definition and those isolating the layer in focus. A multidirectional instrument would give more symmetrical blurring than the author's unidirectional machine, but often at the cost of definition. Definition in a tomogram is bound to be inferior to that in a standard film, and the contrast poorer.

The author usually used a 20-degree amplitude of motion in making his tomograms, although for thinner layers of focus he found 40-degree amplitudes sometimes necessary. As a rule, the distance between sections was 1 cm., and 6 frontal and 8 lateral tomograms were made in covering a knee joint. Simultaneous tomograms were also tried, so that all layers of the knee joint might be studied with two exposures, but the quality of the resulting films was found to be inferior to that of single-film tomograms because of increased blur.

The contours of the articular surfaces of specimens of normal femurs and tibias are shown in a series of tomograms and compared with standard films of the same anatomical preparations sawed into 1-cm. sections. Experimental fractures were also made in anatomical specimens and studied both by tomograph and standard roentgen technic. In the tibia, cortical defects up to 1.5 cm. in diameter were found to be easily overlooked in routine roentgenograms, but were fully demonstrated by tomography. Defects in the underlying spongiosa also were regularly seen only on tomograms, except that when compression was present the standard radiographs had more chance of showing the lesion. In the femur, lesions were usually visualized by both tomography and standard radiography, but frequently the tomographic results were better. Cortical defects in the roof of the intercondylar notch and the middle of the patellar surface of the femurs were best visualized, however, by standard radiography in special projections (axial views of the patella, tangential views of articular surfaces, and 45-degree flexion for the intercondylar notch).

Among 174 patients with clinically manifest recent or old fractures, routine films demonstrated the fracture unequivocally in 106, but in every instance tomography revealed in greater detail the site and extent of the lesion. Fractures were shown doubtfully by standard radiography, but definitely by tomography, in another 12 cases. Eight fractures were seen only on tomograms, all in the lateral tibial condyle.

Forty-eight of the 174 cases showed no radiologic sign of fracture by either standard radiography or tomography. In 33 patients the assumption was that no fracture was present, because they either had no signs of effusion or had hemarthrosis without fat-drops. The 15 patients who had hemarthrosis with fat-drops were believed to have either fissure fractures which were not recognized radiologically or contusions of the fat-pad.

The study of the soft structures of the knee (the most complicated joint in the body) is also facilitated by tomography, frequently in conjunction with arthrography, usually with an opaque medium of the parabrodil type. This procedure the author designates as tomo-arthrography. Because of rapid absorption of the medium from the joint, it was necessary to obtain all the films within twenty minutes.

Standard arthrograms may present difficulties in interpretation because of the presence of recesses in the joint cavity on both medial and lateral sides, which may be large enough to obscure the menisci. Also there are changes in shape and position of the menisci to be taken into consideration with movement of the joint. Because of curves in their surfaces, there are portions of the menisci which are not visualized by tomography in either the frontal or lateral projection.

Experimental tears were made in anatomical specimens and studied by x-ray following immersion in a 10 per cent solution of barium chloride. Tomography usually demonstrated these tears.

Tomo-arthrography was also used to examine the knees of 110 patients. Thirty of these had injuries to the menisci, of which 2 were diagnosed only by standard arthrography, 1 only by tomography, and 27 by both methods. Because of increased blur and impaired contrast, the lesions usually appeared less distinct in the tomograms.

When examination of the cruciate ligaments was particularly indicated, the technic was modified by injection of a larger quantity (about 15 ml.) of the contrast medium to give good filling of the posterior recesses, and by reduction of the distance between sections in the lateral projection to 0.5 cm. With this latter modification, 4 tomograms adequately covered the internal parts of the joint where the ligaments are situated. The tomograms were made in lateral projection only, with the knee flexed, and preferably with the tube moving in a direction parallel to the tibia. In 75 normal cases the ligaments were visualized clearly and distinctly by tomo-arthrography. Ruptures of the anterior part of the anterior ligament also were always clearly shown. The rare lesions of the tibial attachment of the posterior ligament, however, seemed to be demonstrable only indirectly, usually by the presence of an avulsed fragment of bone. Visualization of lesions at the upper attachment of either ligament was usually impossible.

The author concludes that tomo-arthrography is not usually helpful in the examination of injuries of the menisci but is superior to standard arthrography in assessing normal and ruptured cruciate ligaments. Tomography places rather greater demands on the anatomical learning of the radiologist than does standard radiography. It is essential that it be employed to complement and never to replace the standard technic.

Fifty-one illustrations; 1 table.

ARTHUR S. TUCKER, M.D.
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GYNECOLOGY AND OBSTETRICS

New Radiologic Methods in Gynecology. Aortography and Pelvic Arteriography. L. Rossi and B. Maggipinto. *Ann. di radiol. diag.* 29: 41-74, 1956. (In Italian) (Istituto di Radiologia dell'Università e degli Ospedali Riuniti di Parma, Parma, Italy)

Three useful methods of pelvic arteriography have been reported: (1) translumbar aortography; (2) retrograde arteriography by catheter introduced from the femoral artery, according to the method of Fariñas; (3) retrograde transfemoral arteriography according to the method of Castellanos and Pereira.

For aortography, the authors prefer a low injection in order to obtain the best visualization of the pelvic vessels. Compression of the femoral artery during the injection is recommended. In retrograde femoral arteriography, compression of the femoral artery about four inches below the inguinal region is similarly advantageous.

The ovarian artery, being a small vessel, is frequently not demonstrated. It may be visualized by retrograde femoral injection, with compression of the terminal aorta, in 20 to 37.5 per cent of the cases examined, but such compression often causes albuminuria. The uterine artery, having a caliber of about 1 mm., is visible in the majority of studies.

Uterine fibroids present a typical picture. The signs are as follows: (1) displacement of the uterine artery with changes in its caliber; (2) evidence of newly formed vessels surrounding the fibroid (extrinsic vessels); (3) intrinsic vessels of the tumor; (4) the capillary phase (tumor stain).

Ovarian cysts are accompanied by displacement of the uterus and its vasculature. The ovarian artery on the side of the cyst is visible, and its anastomosis with the uterine branches can be demonstrated; the course is around the cyst, which is itself avascular, except for a few slightly tortuous vessels in its wall, originating from the ovarian artery. This permits easy differentiation from fibroids and malignant uterine and ovarian tumors, which have their own rich vasculature. Malignant ovarian tumors have an abundant capillary supply, irregular outline, and few or no large vessels.

The authors prefer low lumbar aortography for visualization of the ovarian arteries. Injection through a catheter introduced into the femoral artery has only rarely been used; direct retrograde percutaneous injection of the femoral artery is employed most frequently. A simultaneous bilateral procedure is preferred.

Twenty-two roentgenograms; 3 photographs; 10 drawings.

ALEXANDER R. MARGULIS, M.D.
University of Minnesota

Occurrence of Free Gas in the Fetus in Cases of Intra-Uterine Death. Olov Fr. Holm. *Acta radiol.* 45: 257-265, April 1956. (Roentgen Department, Länslasarettet, Falköping, Sweden)

A report is made of the systematic radiologic examination of 21 dead fetuses, 13 of which were also examined before parturition, and it is concluded that the demonstration of free gas in the fetus before delivery is of practical importance in the roentgen diagnosis of intra-uterine death.

In all instances, there was gas in the heart, the aorta, and some of the major arteries. In several cases, gas was present also in the inferior vena cava and vessels of the navel. Small amounts of gas in the fetus may fre-

quently be difficult to distinguish from intestinal gas in the mother, and special projections may be required. Views produced with a horizontal beam are occasionally helpful for this purpose.

Nothing is known with certainty regarding the mechanism of gas formation. The author's theory is that it takes place through the decomposition of hemoglobin and the liberation of chemically combined gas. In one case it was demonstrated that 60 to 65 per cent of the gas evacuated from the fetal vessels consisted of oxygen and/or carbon dioxide.

Six roentgenograms; 1 photograph; 1 table.

THEODORE E. KEATS, M.D.
University of Missouri

THE GENITOURINARY SYSTEM

Miokon, A New Intravenous Urographic Medium. Charles H. Nicolai. *J. Urol.* 75: 758-760, April 1956. (Washington University School of Medicine, St. Louis, Mo.)

Miokon, a new medium containing 59.3 per cent iodine, was evaluated in respect to safety and improved visualization of the urinary tract, following its intravenous injection in 1,500 cases. Miokon did not produce proteinuria, urinary cytological changes, or non-protein nitrogen alterations.

Preparation for examination included intestinal purgation, if indicated, and a twelve-hour period of dehydration. Two intravenous sensitivity test doses of 1 to 3 ml., separated by one minute, preceded the giving of the remainder of the 30-ml. dose. In adults the first film was taken at five minutes and in children at three minutes, although in both the medium appears in the collecting system one to two minutes following completion of the injection.

Satisfactory or diagnostic films were obtained in 96.7 per cent of the cases. Reactions, noted in 144 cases, varied from nausea in 50 cases to convulsion (in an epileptic), headache, and chest pressure, occurring in 1 patient each. Arm pain was noted by 11 patients.

Incidental to the investigation of Miokon for urography, 30 translumbar aortograms were obtained, chiefly for the evaluation of peripheral vascular disease. Injection of 30 ml. of the medium in six to eight seconds usually gave satisfactory filling of the aorta and the peripheral arteries of the lower limbs.

The apparent high tissue tolerance for Miokon is indicated by a case in which the inadvertent peri-aortic injection of 30 ml. produced no untoward effects. Urinalyses and non-protein nitrogen determinations following aortography showed no changes.

Two tables.

SAUL SCHEFF, M.D.
Boston, Mass.

Renal Angiography in Experimental Hydronephrosis. Hans Idbohrn. *Acta radiol. Suppl.* 136, 1956. (Roentgen-Diagnostic Department of the University Hospital, Lund, Sweden)

The author presents a detailed study of the angiographic appearance of the renal vessels during unilateral urinary stasis and correlates the x-ray findings after a known period of stasis with renal function and the pathologico-anatomic changes.

The experimental data was obtained from a study of 86 rabbits. After initial angiography, these animals were submitted to left-sided ureteric ligation. Following a varying duration of stasis, changes in the caliber

of the renal artery centrally and peripherally, appearance of the intrarenal arteries, and the nephrographic effect were noted. Since angiographic changes occurred mainly within the first few months, most of the experiments were limited to that period. A third set of angiograms was obtained one to seven days following release of stasis.

The caliber of the left renal artery after stasis, measured as a percentage of the original value and as a percentage of the diameter of the right renal artery at the actual investigation, showed a marked decrease during the first two weeks, followed by a less marked decrease until the ninth to the fourteenth week, after which the curve persisted at a level of 50 to 65 and 35 to 55 per cent, respectively. Using the right renal artery for comparison produced the smaller percentage, as that vessel usually increased in size after ligation of the left ureter.

With development of hydronephrosis, the larger intrarenal arterial branches were more or less markedly separated, straightened, and narrowed, sometimes ending abruptly, while the finer branches were shortened and reduced in number. These changes in the intrarenal arteries, and also in the nephrographic effect, showed a highly significant correlation with the duration of stasis during the first ten to eleven weeks. After ten weeks, the nephrographic effect was extremely weak or absent. Function of the hydronephrotic kidney was always good when ureterostomy was performed within a week of the onset of stasis but almost completely impaired after stasis of more than four weeks' duration.

Comparison of the angiographic changes showed that the curve for the caliber of the renal artery differed widely in shape from the curves for function and for the pathologic-anatomic changes. Only during the first two weeks did the curves run a similar course. The curve for intrarenal arterial change resembled that for the caliber of the renal artery, while the curve for the nephrographic effect after ureterostomy showed the best agreement with that for function.

Also discussed are a series of individual correlations involving such factors as function after ureterostomy, blood flow through the left kidney, the histologic changes, and the thickness of the renal cortex, as well as the angiographic changes.

Fifty-one roentgenograms; 9 photomicrographs; 8 photographs; 32 graphs.

CHARLES M. GREENWALD, M.D.
Cleveland Clinic

The Roentgen Diagnosis of Renal Neoplasms. J. H. Woodruff, Jr., C. C. Chalek, R. E. Ottoman, and S. P. Wilk. *J. Urol.* 75: 615-626, April 1956. (1124 W. Carson St., Torrance, Calif.)

This paper seeks to evaluate the various radiologic methods for the study of renal neoplasms. On the 26 plain films available for study, the findings ranged from a renal mass in 14 to displacement of the kidney shadow in 3.

While retrograde pyelography is generally more helpful in outlining a renal neoplasm, intravenous urograms are of value in case finding as well as for delayed studies in the presence of ureteral obstruction. Both preliminary films and pyelograms or urograms failed to show tumor in 7 of the 26 cases because of the small size of the growth, its peripheral location in the kidney, superimposed hydronephrosis, or widespread

polycystic disease. Other shortcomings of pyelography and urography cited in the literature are the similarity in appearance of pelvic and calyceal distortion by both intra- and extrarenal tumors, failure to indicate the extent of the lesion, and the inability to visualize anterior or posterior hemangiomas of the walls of the pelvis. Renal displacement is best appreciated by pyelography, particularly when the ureter is viewed in its entirety and when lateral exposures are made. Plain films plus pyelography are adequate in demonstrating a mass in most cases.

Antegrade pyelography, the percutaneous injection of contrast material into the renal pelvis, may assist in the differentiation between malignant and non-malignant hydronephrosis as well as revealing implants along the lower ureter.

Aortography showed tumor staining in 8 or 9 cases. The advantages of this method include the demonstration of extension of tumor into the renal vein in most cases, visualization of tumor where pyelography has failed (hemangiomas, small tumors, polycystic masking), and the possibility of differentiating renal cancer from extrarenal tumors and cystic and benign growths in the kidney. Aortography may fail to show tumor vessels because of cystic degeneration, avascularity, or necrosis in the growth or because of poor timing of exposures. Adenomas, pelvic tumors, metastatic carcinomas, and some primary carcinomas may not show the tumor staining seen in most cortical tumors.

Presacral air injection, alone or in combination with aortography, pyelography, or planigraphy, may occasionally be of help in delimiting renal from extrarenal masses. Visualization of the kidney may not be obtained however, as a result of the extreme size of the tumor or of perirenal inflammation or extension.

Percutaneous filling of a cyst cavity with contrast material after aspiration followed by microscopy of the aspirate with or without aortography will aid in distinguishing between tumor and cyst in an occasional perplexing situation.

Opacification of the vena cava may show obstruction of the vessel below the renal vein, with visualization of the venous collaterals, as well as displacements of the vena cava and filling defects within it. While obstruction of the cava is not invariably a sign of invasion, its presence may alter the surgical approach.

Laminagraphy has not been used by the authors, but the literature cites its usefulness.

The authors studied nephrograms only incidentally to aortograms. Retention of some contrast medium by tumors, producing a diffuse, ill-defined density, in contrast to a sharply outlined lucent defect in cysts, is an important differential point.

Bone lesions visualized roentgenographically may be the first clinical sign of a renal cancer. While these are most often lytic, they are occasionally osteoblastic in nature. Pulmonary metastases are usually multiple, small, roughly rounded and sharply outlined. Gastrointestinal study of patients with right renal masses shows depression of the hepatic flexure, anterior displacement and external pressure on the right half of the colon, displacement of the antrum and first two portions of the duodenum to the left. Left kidney masses cause anterior displacement of the stomach and in some cases anterolateral displacement of the left colon.

Ten roentgenograms; 4 tables.

SAUL SCHEFF, M.D.
Boston, Mass.

Megaloureter. Evan L. Lewis and Richard W. Cletsoway. *J. Urol.* 75: 643-649, April 1956. (Tokyo Army Hospital, 8059th Army Unit, APO 500, San Francisco, Calif.)

Restriction of use of the term "megaloureter" to ureteral dilatation occurring on a neurogenic basis is recommended in this article. Such cases are likened by the authors to esophageal achalasia. They are characterized by ureteral dilatation without tortuosity, presence of peristalsis in the dilated portion, and absence of obstruction in the genitourinary tract. (No definite neurologic defects have yet been demonstrated.)

Radiographically, the ureter appears dilated, especially at its lower end, at times associated with mild hydronephrosis. Retrograde urography performed under the fluoroscope helps to determine whether the ureter is atonic or normally contractile.

Treatment consists of reimplantation of the dilated ureter into the bladder wall. The authors describe a new technic which prevents stricture and reflux and results in a return to normal size in six to nine weeks. Six cases are reported.

Six roentgenograms; 1 drawing.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

The Reliability of Roentgen Signs of Varying Degrees of Malignancy of Bladder Tumors. C. Franksson, K. Lindblom, and W. Whitehouse. *Acta radiol.* 45: 266-272, April 1956. (Roentgen Diagnostic Department, Karolinska Sjukhuset, Stockholm, Sweden)

The authors have reviewed 117 cases of bladder tumor. The roentgenographic appearances were analyzed with reference to the thickness of the bladder wall adjacent to the tumor, the intraluminal contour of the tumor, and ureteral block. The roentgenographic examination was found to be valuable in differentiating between benign and malignant tumors. In most cases, both excretory urography and urethrocytography were performed.

From the data obtained, the authors conclude that clearly benign and obviously malignant bladder tumors may be differentiated roentgenologically. In an intermediate group, however, the degree of malignancy may be doubtful and the roentgenographic examination is then complementary to other methods of investigation. In questionable cases, thickening of the bladder wall, a sloping contour of the tumor, and ureteral block were considered signs of infiltrating growth of the tumor.

Five roentgenograms.

THEODORE E. KEATS, M.D.
University of Missouri

Positive Pressure Urethrography: A New Diagnostic Method. Hugh James Davis and Louis G. Cian. *J. Urol.* 75: 753-757, April 1956. (The Johns Hopkins Hospital, Baltimore 5, Md.)

Suburethral diverticula are said to be present much more often than can be demonstrated with present diagnostic methods. The importance of these pouches in recurrent urinary tract infection is well known. The authors have devised a modified Foley catheter which not only demonstrates the existence of the diverticula but also localizes paraurethral ducts and minute sinus tracts leading to paraurethral abscesses for easier sur-

gical excision. A Foley catheter (14F) is inserted into the bladder with an aperture cut proximal to the bag and the distal opening of the catheter sealed. With the inflated bulb drawn tight against the internal sphincter, a contrast medium is injected until a reflux appears at the external meatus. The urethra is then converted into a closed tube by an external sliding balloon which is applied against the external meatus to act as a tamponade while 3 to 4 c.c. additional contrast medium is instilled.

The authors present 4 cases in which demonstration of diverticula by this new method led to excision and cure.

Four roentgenograms; 1 drawing.

SAUL SCHEFF, M.D.
Boston, Mass.

TECHNIC

Monochromatic Roentgen Rays in Contrast Media Roentgenography. Michel Ter-Pogossian. *Acta radiol.* 45: 313-322, April 1956.

This study was made in order to determine how variation of roentgen-ray quality affects the diagnostic usefulness of iodine-containing contrast media. An apparatus for measuring the absorption coefficient of iodine was devised, and comparisons were made with the iodine exposed to conventional polychromatic x-rays and to essentially monochromatic x-rays. Intensities were 90, 70 and 40 kvp for the conventional x-rays, and of the order of 35 kvp for the monochromatic rays.

It was found that with the use of monochromatic radiation, iodine contrast media have greater opacity and therefore better contrast quality. Concentrations of the medium two to three times lower than those ordinarily used in radiography produced suitable shadows for roentgen diagnosis.

The patient exposure from the lower intensity monochromatic radiation was found to be within acceptable safe limits, although greater than would be the case with conventional methods.

Seven illustrations; 2 tables.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Television in Diagnostic Roentgenology. R. Janker. *Röntgen-Blätter* 9: 118-126, April 1956. (In German) (Röntgeninstitut, Bonn, Germany)

While proper reference is made to the work of Colman, Morgan, and others in this country, the author describes cursorily his independently performed experiments (some of which date as far back as 1932), culminating in the transmission over the German television network, on Feb. 28, 1956, of a fluoroscopic study of the gastrointestinal tract. He used 90 kv, 5 ma, a Patterson B 2 fluorescent screen, a Leitz 1:0.85 lens (actually an aperture of about 1:4.5 was obtained), and an American made Orthicon television tube coupled to a Philips 14-cm. electronic intensifier.

Detail and brightness of the transmitted image are satisfactory for teaching and demonstration purposes. Experimentation is being continued to achieve further improvement. At this time the expense of the installation would preclude diagnostic service from a distance.

Twenty illustrations.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

MISCELLANEOUS

Acute Intermittent Porphyrria with Acute Abdominal Findings and Palpable Mass. Wesley Furste and Perry R. Ayres. *Arch. Surg.* 72: 426-430, March 1956. (W. F., 327 E. State St., Columbus 15, Ohio)

The porphyrins are end-products in the metabolism of such pigments as chlorophyll, hemoglobin, and myoglobin. Normally the small amount of porphyrin resulting from either the build-up or break-down of hemoglobin is excreted in the urine. In porphyria there is an error, congenital or acquired, in this step of metabolism, with the accumulation of porphyrins in the body and increased excretion in the urine. Recently the types of porphyria have been classified as photosensitive, intermittent acute, and a mixed variety. The intermittent acute type may cause acute abdominal symptoms simulating a variety of surgical emergencies. The entity is rare, appears in the third or fourth decades of life, and is found chiefly in women.

The most important symptom of acute intermittent porphyria is severe abdominal pain, usually of a colicky nature. Vomiting may precede the onset of pain; usually there is a history of constipation of several days to weeks duration. No specific signs are uncovered by

physical examination. Leukocytosis may be manifest during an acute attack, but other laboratory findings are not helpful. The diagnosis is made by demonstrating porphobilinogen or abnormal porphyrins by one of the following urine examinations: (1) the Watson-Schwartz test for porphobilinogen; (2) exposure of acid urine to sunlight; (3) spectroscopy; (4) determination of the melting point of porphyrins.

Roentgenographic studies show a variety of non-specific findings from day to day, without a definite pattern. Dilated or distended loops of intestine, with or without fluid levels, may appear temporarily. Mechanical obstruction is rare. Ingested barium passes through the intestine more slowly than usual, and there may be an area of spasm. A barium enema demonstrates a dilated colon which empties very slowly.

The authors report the case of a forty-year-old female with porphyria in whom barium studies were done. A mass appeared in the right lower quadrant which proved to be a slow-moving bolus of barium. Serial study showed gradual progression of this mass into the colon and final elimination.

Four roentgenograms; 2 tables.

SAUL SCHEFF, M.D.
Boston, Mass.

RADIOTHERAPY

The Response of Esophageal Cancer to Irradiation. A Serial Cytologic Study of Two Cases. Moshe B. Goldgraber. *Gastroenterology* 30: 618-624, April 1956. (University of Chicago Clinics, Chicago 37, Ill.)

Two cases of esophageal cancer, one epidermoid and the other recurrent basal-cell carcinoma, were followed by serial esophageal washings and cytologic examinations during prolonged x-ray therapy. Cellular radioresistance was evident throughout treatment.

In the case of epidermoid carcinoma a total tumor dose of 5,000 r was given over a period of two months. The basal-cell carcinoma received a similar initial course of treatment, with disappearance of the filling defect. Recurrence was noted three and a half months later and another course of x-ray treatment was given.

The cytologic changes in the malignant cells during treatment are described. These were also observed to a striking degree in the benign cells. At the conclusion of therapy in the epidermoid carcinoma, about 75 per cent of all cells showed no features of the irradiation effect; in the second case at the termination of therapy, the overall picture was similar to that observed prior to treatment.

The cases are compared to similar studies, by other authors, on carcinoma of the uterine cervix and fall into the "poor response" group. With carcinoma of the cervix, at least 70 per cent of the cells must react to x-ray in order to put the case in the "good response" category.

Fourteen photomicrographs. ALVIN SEGEL, M.D.
Cleveland City Hospital

Some Radiosensitive Bone Tumours. A. L. Eyre-Brook. *J. Fac. Radiologists* 7: 222-229, April 1956. (Bristol, England)

The Histological Diagnosis of Undifferentiated Tu-

mours in Bone. T. F. Hewer. *J. Fac. Radiologists* 7: 230-236, April 1956. (University of Bristol, Bristol, England)

The Grading of Osteogenic Sarcoma, and Its Bearing Upon Survival and Prognosis. C. H. G. Price. *J. Fac. Radiologists* 7: 237-241, April 1956. (University of Bristol, Bristol, England)

Radiosensitive Bone Tumours—Radiological Aspects. F. G. M. Ross. *J. Fac. Radiologists* 7: 242-252, April 1956. (United Bristol Hospitals, Bristol, England)

Some Radiosensitive Bone Tumours. Robert C. Tudway. *J. Fac. Radiologists* 7: 253-259, April 1956. (Bristol Royal Hospital, Bristol, England)

This series of articles is presented as a symposium and review of neoplasms of the Bristol Bone Tumour Register. The discussions revolve mainly around the relatively few bone tumors which are radiosensitive, that is, reticulum-cell sarcoma, secondary neuroblastoma of bone, malignant synovioma, and Ewing's tumor.

The first paper, by Eyre-Brook, an orthopedic surgeon, gives some figures from the Bristol Register and touches upon the indications for surgery and radiotherapy. He appears to favor surgical eradication for accessible tumors and to interpret accessible fairly liberally.

Hewer, a pathologist, opens his contribution with the statement that when one sees a section of bone tumor in which the chief histologic feature is the presence of rounded cells in a scanty stroma, with no immediate diagnostic pattern, it is customary to consider the types mentioned above (as well as plasma-cell myeloma and secondary carcinoma).

Reticulosarcoma is characterized by pleomorphic cells with many mitoses. Fibrils of reticulin forming a stroma or permeating the section are practically specific.

Neuroblastoma characteristically shows neuroblasts grouped in masses with a tangle of nerve fibers in the center to form rosettes. If section is not made through the center of the rosette, sheets of rounded cells with no recognizable features may be seen, so that study of several sections may be required.

Malignant synovioma shows masses of round cells containing clefts or small synovial compartments lined with reticulin and plump cells resembling endothelial cells.

Ewing's tumor histologically is simply an undifferentiated round-cell tumor. All 10 "Ewing's tumors" in the Bristol series on close scrutiny were found to belong in other categories.

The radiographic aspects of radiosensitive bone tumors are the subject of the paper by Ross. Radiographically reticulosarcoma and secondary neuroblastoma of bone appear somewhat alike. Both occur most commonly in the medullary portion of long bones. Neuroblastoma, however, usually involves more than one bone, and this multiplicity is helpful in differential diagnosis. When first seen, neuroblastomas are extensive and tend to involve a greater length of bone shaft than do the reticulosarcomas.

The early appearance is that of a group of small translucencies which are fairly localized, but which have ill-defined margins. Later the small areas of destruction become confluent and extend along the shaft. Cortical destruction may then occur in the same patchy manner. Islands of apparently normal bone may remain completely surrounded by destroyed medulla.

In reticulosarcoma, periosteal layering or fine spiculation may occur, but it is never very marked. Productive changes are usually slight. Any soft-tissue tumor which may be present is usually small. Calcification is not seen within it, but cortical bone may be displaced into it.

Conversely, in secondary neuroblastoma layered periosteal new-bone formation is frequently seen, spiculation extending out into the soft-tissue tumor is conspicuous, and medullary bone production occurs in about one-third of cases. Soft-tissue tumor is usually present, and may be large, but does not show calcification.

Malignant synovioma usually arises close to a joint, but may occur in bursae or tendon sheaths anywhere. A well defined soft-tissue tumor with a regular or lobulated outline is seen. Irregular calcifications may be contained within it. The tumor does not often invade bone, but causes irregular cortical and medullary destruction beneath it. The area of bone involvement is small relative to the size of the soft-tissue mass, and has ill-defined margins.

Treatment with deep x-ray was carried out in many of the cases of the Bristol series. Tudway discusses this phase of the subject. Having been given 2,000 to 4,000 r through wide ports over four weeks time, about half of the patients with reticulosarcomas had survived six years. The bone regenerated, leaving cortical thickening, slightly increased density, and mild trabecular coarsening.

In neuroblastomas of bone, response to irradiation is usually good. Afterward the bone shows residual widening and increased density. However, sooner or later, further destruction at the site is inevitable. All the patients in this series died.

In malignant synovioma local excision is unsatisfactory. High-energy radiation is first choice for ther-

apy, with amputation the only reliable alternative. Following high-dose irradiation (7,500 r in nine weeks), a six-and-a-half-year survival without recurrence is recorded. Another three-year survivor is mentioned in whom radionecrosis necessitated leg amputation, but who shows no recurrence.

Price's contribution has to do with osteogenic sarcoma rather than any of the tumors discussed by his colleagues. He considers briefly the implications of the histologic grade of a sarcoma and the probable manner in which this feature of tumor growth is related to the concepts of radiosensitivity and radiocurability. While accurate prognosis in bone tumors is not possible with our present knowledge of histologic grading, the mitotic ratio (M.R.) is useful in making comparisons between bone sarcomas, and has correlated quite well with survivals. Using selected sections through areas of homogeneous, viable, cellular tissue, tumor-cell nuclei are counted and expressed as a ratio with the number of mitoses present. Grades I through III indicate mitotic ratio ranges from 1200:1 to less than 100:1. The latter have in this series been found to have 12 per cent chance for two-year survival as compared with 75 per cent chance for five-year survival in Grade I. Other factors which influence length of survival are: tumor size, site, stage when treated, histological subtype, age of host at onset, and concomitant skeletal disease.

These papers are well illustrated (Eyre-Brook, 10 roentgenograms, 3 tables; Hower, 13 photomicrographs; Price, 4 graphs, 1 table; Ross, 27 roentgenograms, 1 photograph; Tudway, 6 roentgenograms, 3 tables).

DON E. MATTHIASEN, M.D.
Phoenix, Ariz.

Two Million Volt Irradiation Therapy for Inoperable Carcinoma of the Lung. Ruth J. Guttman. Cancer 8: 1254-1260, November-December 1955. (Francis Delafield Hospital, College of Physicians and Surgeons, New York, N. Y.)

Between January 1951 and October 1954, 100 patients with far advanced, inoperable carcinoma of the lung were treated at the Francis Delafield Hospital with a tumor dose of 4,000 to 6,000 r, on a 2,000-kv. machine. Eighty-four of these patients were followed for more than three months. Sixty-three derived definite symptomatic benefit from the irradiation. Twenty-seven patients lived longer than one year. Of these, 11 had reached one year at the time of the report; 4 had lived more than two years; 1, more than three years; and 1, more than four years.

All the patients who lived longer than eighteen months received a tumor dose of at least 5,000 r in five weeks time. Age, sex, and location of the tumor did not seem to have an effect upon the success or failure of therapy. It seems significant, however, that the best response to 2,000-kv. therapy was obtained in patients with squamous-cell, oat-cell, and undifferentiated carcinoma. It is also apparent that the best results were obtained from a total tumor dose of 5,000 to 6,000 r. Twenty-four patients were alive at the time of the report. The elapsed time since completion of their treatment was on the average more than twelve months. Nineteen patients were completely symptom-free. The author expects the outlook for these patients to be better, since they all received 5,000 r or more. She believes that the results in treating advanced inoperable carcinoma of the lung with the 2,000-kv. unit

are encouraging and that the method merits further continuation and investigation.

Thirteen figures, including 2 roentgenograms; 3 tables.

The Intensive Divided-Dose Irradiation Therapy of Carcinoma of the Uterine Cervix: Rationale and Late Results. Robert E. Fricke and David G. Decker. *Acta radiol. Interamericana* 5: 63-70, July-August-September 1955. (Mayo Foundation, Rochester, Minn.)

The technic of radiation treatment of carcinoma of the cervix in use at the Mayo Clinic is described, and the results over a thirty-four-year period are tabulated. Reliance is placed primarily upon radium, with roentgen therapy employed as a supplement to prevent metastases to the lateral pelvic lymph nodes. The main principles of the method are homogeneous irradiation along the entire birth canal, intensive treatment over a period of four weeks (twice weekly), no dilatation of the cervix beyond that caused by the placement of the 4.0 mm. wide radium tube, and avoidance of trauma.

The results of treatment between 1915 and 1939 (see Bowling and Fricke: *J.A.M.A.* 137: 935, 1948. *Abst. in Radiology* 52: 902, 1949) are compared with those for 1940 to 1948. The authors note that the general principles of radium treatment have not altered since the commencement of radium therapy at the Clinic in 1915, but rather marked changes have been made in the technic for roentgen therapy, particularly in recent years. Between 1940 and 1948, 1,309 cases of cervical carcinoma were seen, of which 1,059 were treated by radiation therapy alone; 964 of these were satisfactorily traced. The overall five-year survival rate of 51.7 per cent for the traced patients in the irradiated group shows a gratifying increase over the 32.8 per cent in the earlier group. If all untraced patients are considered to have died of cancer, the absolute survival rate in the present series is 47.0 per cent. The authors consider that these superior results are probably due both to minor improvements in technic and to earlier diagnosis and institution of therapy.

Five tables.

Carcinoma of the Uterine Cervix. Four Years of Cooperation of Gynecologist and Radiotherapist. John A. Isherwood, John W. Simpson, and Eugene L. Saenger. *Texas State J. Med.* 52: 229-233, April 1956. (J. A. I., Brooke Army Hospital, Fort Sam Houston, Texas)

A preliminary report on a small cervical carcinoma series (84 cases) is presented from Brooke Army Hospital. The number of patients in each stage is too small to be statistically significant, and the longest follow-up was four years, so that comparison with other series is impossible as to results.

Patients in Stage I in good condition were operated upon; those not considered good risks were treated with radium only if the lesion was very early. All others received the usual combination of radium and external roentgen therapy. The radium was used in an Ernst type applicator, 7,000 mg. hours being administered in divided doses with a four-day rest between. The radium application was made in the middle of the course of the external therapy. The latter comprised 3,000 r in air to each of six fields (anterior, sacral, and gluteal), at 210 kv, with a half-value layer of 1.0 mm

of copper. The entire course covered about fifty-three days.

The authors stress the importance of a planned therapeutic program followed for a long enough period that suitable comparisons can be made between series in different clinics in order to provide a uniformly effective method of therapy for this disease.

One photograph; 2 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Carcinoma of the Cervix Associated with Pregnancy. Glen E. Hayden. *Am. J. Obst. & Gynec.* 71: 780-789, April 1956. (Department of Obstetrics and Gynecology, University of Chicago, Chicago 37, Ill.)

From 1931 to 1954 over 81,806 obstetric patients were seen at the Chicago Lying-in Hospital, and in only 12 was there a diagnosis of cervical carcinoma co-existing with pregnancy, an incidence of 0.014 per cent. Ten of the tumors were of the squamous-cell variety and 2 were adenocarcinomas. According to the League of Nations classification, 3 were of Stage I, 7 of Stage II, and 2 of Stage III.

The five-year survival rate was 50 per cent. Clinical staging was the most reliable prognostic criterion. Thus, in Stage I there were 100 per cent survivals, in Stage II 42.8 per cent, and in Stage III none. Unfavorable influence of pregnancy could be demonstrated; fetal mortality was only slightly increased.

In Stage I and II cases, the method of treatment was cesarean section with Wertheim hysterectomy and lymphadenectomy. If the cervix was extensively involved, radium was sutured in the canal for 4,000 mg. hours, with subsequent cesarean section and radical surgery, or, in the event of parametrial involvement, with subtotal hysterectomy (so that 3 or 4 cm. remained for further radiotherapy) and deep x-ray irradiation to the parametria.

Three photomicrographs; 5 tables.

ROBERT L. EGAN, M.D.
Houston, Texas

Superiority of Surgical Treatment of Endometrial Carcinoma. J. Chandler Smith. *J.A.M.A.* 160: 1460-1464, April 28, 1956. (705 Cooper St., Saginaw, Mich.)

The basic tenet of therapy of endometrial carcinoma, according to the author, is the eradication of all tumor cells from the largest amount of pelvic tissue with the least possible delay after diagnosis. Surgical treatment, therefore, is superior to combined operative and radiation therapy. Not only does irradiation clear tumor cells from less tissue than can be done by hysterectomy, but the delay incident to delivery of an adequate dose may enable surviving tumor cells to spread. It is felt that any slight difference in survival rates is more apparent than real and is colored by the variables of the analysis as well as the limited number of cases available for evaluation.

One photomicrograph; 1 drawing; 4 tables.

SAUL SCHEFF, M.D.
Boston, Mass.

Vaginal Metastases Following Treatment of Endometrial Carcinoma. Richard W. Stander. *Am. J. Obst. & Gynec.* 71: 776-779, April 1956. (Department of Obstetrics and Gynecology, University of Michigan, Ann Arbor, Mich.)

During the twenty-year period preceding 1950, a

total of 278 patients with untreated endometrial carcinoma were admitted to the University of Michigan Hospital. Seven patients had vaginal extension when first seen and in 8 others vaginal recurrences developed, making the total incidence 5.4 per cent. Previously Way had reported the incidence of vaginal involvement as 17.7 per cent and Meigs as 12.1 per cent. Adenocarcinomas with marked squamous metaplasia were more likely to give rise to vaginal metastases than pure adenocarcinomas; the lower anterior vaginal wall was the most frequent site of spread.

With a single exception, the vaginal lesions in this series were treated by local radium irradiation. Only 1 patient survived for five years. These poor results are due, however, not to the vaginal disease *per se*, but to abdominal extension, as the local lesion was controlled in 50 per cent of the treated cases.

The author believes that the number of vaginal recurrences could be definitely reduced if preoperative external irradiation was used in surgically treated cases of endometrial cancer.

Of 103 patients in his series receiving external irradiation prior to total hysterectomy, only 1 had a vaginal lesion subsequently. This low rate is compared to figures from the literature, showing 4.3 to 15.3 per cent vaginal recurrence following hysterectomy only; 10 per cent following hysterectomy and postoperative external irradiation.

The time lapse between treatment of the primary carcinoma and the appearance of the vaginal metastases ranged from two to ninety-two months, with an average of twenty-three months.

Five tables.

ROBERT L. EGAN, M.D.
Houston, Texas

Spindle Cell Sarcoma of the Vagina. A Case Treated by Radium Implant. Paul Strickland and H. C. Perry. *J. Obst. & Gynaec. Brit. Emp.* **63**: 280-281, April 1956. (Mount Vernon Hospital, Hillingdon, Middlesex, England)

The authors report a case of sarcoma of the anterior wall of the vagina which was discovered ten years following a spontaneous and sudden menopause and one month following anterior colporrhaphy. The lesion was implanted with dumb-bell radium needles, supplemented by an intravaginal radium ovoid, to yield a total tumor dose of 7,000 r. Considerable fibrosis developed in the treated area, but thirty-two months after the original implant the patient was well, the degree of post-irradiation thickening was diminishing steadily, and there was no clinical evidence of residual or recurrent disease.

One roentgenogram; 2 photomicrographs.

JAMES E. BAUER, M.D.
University of Missouri

Radiation Menopause or Hysterectomy. Part II. Mortality, Morbidity, and Subsequent Pelvic Cancer. A. C. Turnbull. *J. Obst. & Gynaec. Brit. Emp.* **63**: 179-188, April 1956. (Gynaecological Unit, Aberdeen Royal Infirmary, Aberdeen, Scotland)

The author states that results published in Part I of this study (*J. Obst. & Gynaec. Brit. Emp.* **62**: 176, 1955. *Abst. in Radiology* **65**: 960, 1955) "suggest that one should not be deterred from inducing the menopause by radium because of the risk of causing severe or unpleasant menopausal symptoms; the incidence of such symptoms in a group of women so treated was prac-

tically the same as in a control group who had experienced a natural menopause." In Part II, the radiation menopause and hysterectomy are discussed from the point of view of primary mortality and morbidity and the risk of subsequent cancer of the genital tract.

Of 1,105 patients admitted to Aberdeen Royal Infirmary between January 1938 and December 1947 because of benign uterine hemorrhage (exclusive of women under thirty years of age and those treated for bleeding after the menopause), 739 were treated by irradiation and 366 by hysterectomy (total or subtotal). The mortality was 0.4 per cent in the irradiated cases and 0.8 per cent in those treated surgically. In a more recent series of 802 cases of irregular uterine hemorrhages seen between 1951 and 1953, irradiation was used in 497 cases, with no deaths, and hysterectomy in 305 cases, with 1 death.

In the original series of 1,105 cases, the incidence of immediate complications after hysterectomy (43.4 per cent) was twelve times that after irradiation (3.5 per cent). Thirty-three of the 739 patients treated by radiation are known to have been subsequently readmitted to the hospital with further symptoms unrelated to malignant disease, while of the 366 cases treated by hysterectomy, 6 are known to have been readmitted. Analysis shows that the excess readmission rate in the radiation cases was due in large measure to recurrent hemorrhage, which was subsequently successfully treated.

Carcinoma of the uterus is known to have developed in 10 (1.34 per cent) of the 739 irradiated patients in a period of six to sixteen years, and in 3 (0.82 per cent) of those treated surgically. The fact that the ratio of cancer of the body to cancer of the cervix following radiation-induced menopause is the same as after a natural menopause in the same age group suggests to the author that, although the small amount of radiation given does not prevent the development of endometrial cancer, it does not predispose to it. [We fail to see how the similarity of ratios warrants the conclusion that the total incidence is the same, though it well may be.—J. E. B.]

From the data presented, it appears that all of the cases of cancer of the cervix appearing after irradiation, of cancer of the cervical stump following subtotal hysterectomy and of cancer of the vault following total hysterectomy were in parous individuals.

The comparison of irradiation and hysterectomy in the treatment of irregular uterine hemorrhage indicates:

(1) That the immediate risk of death is greater with hysterectomy than with irradiation, and would probably be even greater if the poor surgical risk patients now treated by irradiation underwent hysterectomy.

(2) That irradiation is not as effective in stopping the bleeding as is hysterectomy, but that the incidence of recurrent bleeding is low and that it is effectively dealt with on the second occasion.

(3) That late sequelae in the radiation-treated cases are more common but less serious than those in the surgically treated cases.

(4) That there is no evidence that radiation increases the chance that cancer will develop in the pelvis but that, unlike hysterectomy, it cannot reduce the chance.

(5) That if the number of deaths which have subsequently occurred from cancer be added to the primary mortality in the appropriate group, the total mortality is about the same for both types of treatment, since

the lower primary mortality in the radiation series is compensated for by the smaller number of deaths from subsequent cancer in the operated group.

The conclusion reached is that at present the best results, both short- and long-term, are likely to be obtained by a judicious use of both methods.

Five tables.

JAMES E. BAUER, M.D.
University of Missouri

Carcinoma of the Scrotum. Gustave Kaplan, Howard Adler, and Bernard Roswit. *Arch. Surg.* 72: 445-449, March 1956. (VA Hospital, Bronx, N. Y.)

The authors present a case of carcinoma of the scrotum in a fifty-six-year-old man. A left orchiectomy was done in October 1952, with excision of a left scrotal carcinoma; a right radical ileoinguinal lymph-node dissection for metastases was performed nine months later, and in November 1953 the patient returned to the hospital because of swelling in the right groin, right leg, and remaining scrotal area. An attempt to excise the mass, which had its onset before the second admission, was unsuccessful. A program of radiotherapy was instituted, with the following factors: 1,000 kv, 3.9 mm. lead half-value layer, 70 cm. target-skin distance, a field 17×17 cm. A tissue dose of 3,000 r was delivered in a twenty-eight-day period. The tumor, which measured 10×15 cm. at the beginning of therapy, was reduced to 4×6 cm. within one month after completion of treatment. Subsequent chest roentgenograms revealed numerous metastatic nodules and an intravenous pyelogram showed tumor indentation of the bladder. Death occurred approximately seventeen months after the first admission to the hospital.

The highly malignant character of scrotal carcinoma is emphasized; mention is made of the vast lymphatic anastomosis between the two sides of the scrotal sac, which allows swift metastasis to both groins. Treatment is surgical, and the role of radiotherapy is considered to be palliative only.

It is of interest that the authors' patient gave a history of occupational contact with a known carcinogenic substance, namely, tar.

Two roentgenograms; 2 photographs; 1 photomicrograph; 1 drawing.

Tubeless Gastric Analysis in the Study of Acid Secretion Following Gastric Irradiation for Peptic Ulcer. John T. Galambos and Joseph B. Kirsner. *Gastroenterology* 30: 598-601, April 1956. (J. T. G., Emory University, Atlanta, Ga.)

Thirty-three patients with peptic ulcer were studied at intervals for one to eight months by conventional gastric analysis and by tubeless gastric analysis with quinine exchange resin (Diagnex), prior to and following roentgen irradiation of the stomach. The principal purpose of the study was to evaluate tubeless analysis as an index of the antisecretory effect of gastric irradiation.

The total amount of irradiation was 1,600 r, administered in divided doses over a period of ten days. In 19 of the 33, the one-hour basal secretion decreased to zero, with a significant decrease noted in another 5. In the remaining 9, no significant decrease was noted.

There was a direct correlation of these results and the tubeless gastric analyses in 24 cases. In 4 of the remaining cases, the results of the tubeless gastric analyses became 0, while the basal secretion decreased significantly. In 1 patient there was satisfactory corre-

lation between the two tests following roentgen therapy; however, the pretreatment tubeless gastric analyses reading had been 0 despite the demonstration of hydrochloric acid in the gastric content. In 4 instances there was no correlation between the two methods.

The present data would appear to indicate that as long as the tubeless gastric analysis remains consistently negative and the patient remains free of symptoms, conventional gastric analysis may be deferred. However, with the reappearance of acid, tubeless gastric analysis no longer reports accurately the quantity of gastric secretion.

One table.

ALVIN SEGEL, M.D.
Cleveland City Hospital

Clinical Evaluation of Results in Supervoltage X-ray Therapy. G. W. Blomfield. *J. Fac. Radiologists* 7: 260-277, April 1956. (University of Sheffield, Sheffield, England)

This article discusses the usefulness of 2,000,000-volt x-rays in treating cancer at the Sheffield National Centre for Radiotherapy over the past five years. Human factors and clinical evaluation of results breed so many variables that comparisons are difficult, but it is quite clear that ease of treatment, greater patient comfort during treatment, and lack of troublesome complications are advantages of supervoltage irradiation. The expected disadvantages from overdosage to deep tissues and induration of subcutaneous areolar tissues were not encountered in any of the 1,500 cases of the series.

The author reports his results according to anatomical sites:

Mouth: Excellent palliative results were obtained with minimal side effects. Higher doses could be delivered to the lesions without causing bone necrosis. Skin reactions were practically non-existent. Mucosal reactions were vigorous. No startling cures were effected.

Larynx: Here there was great advantage in the absence of cartilage and bone necrosis and absence of skin reactions. Two opposing fields were usually treated, for a depth dose of 1,000 r per week. Survival rates at the date of the report were not complete enough for comparison, but early figures showed improvement over older conventional treatment records.

Bronchus: As compared with ordinary x-ray therapy, supervoltage radiation could be delivered with more precision and with less damage to the rest of the lung. Palliation was easier to obtain.

Esophagus: In esophageal cancer intracavitary treatment with radioactive tantalum wire was carried to a 3,000 r tumor dose. Another 3,000 r was then given by external irradiation. Some cases were treated with rotational therapy. The average survival time was five to eight months. Two patients out of 28 had survived three years.

Intracranial Tumors: Low dosage to the cranium, occasional avoidance of permanent epilation, and ease of treatment were the principal advantages here. Survival statistics were unremarkable.

Pituitary Tumors: Rotational therapy with supervoltage x-rays proved to afford much better isodose distribution than the older conventional multiple-field techniques.

Rectum: Two or 3 good results were recorded.

Bladder: Much better results were obtained and less reaction than with older conventional methods.

Breast: Only a few cases were treated. The main

value would seem to lie in the treatment of axillary and cervical nodes.

Uterine Cervix: Gains over previous years appear to be considerable, but final evaluation of results must be postponed. The chief improvement was in Stages II and III. Femoral fractures and bladder and rectal complications have been avoided. Combined therapy with radium treatment preceding the super-voltage irradiation was routinely carried out.

Fourteen photographs; 9 charts; 10 tables.

DON E. MATTHIEN, M.D.
Phoenix, Ariz.

Preliminary Report on the Clinical Use of the Medical Research Council 8 MeV Linear Accelerator. R. Morrison, G. R. Newbery and T. J. Deeley. *Brit. J. Radiol.* 29: 177-186, April 1956. (Hammersmith Hospital, London, England)

This paper is concerned with the use of an 8-MEV linear accelerator in the first year following its installation in the Radiotherapeutic Research Unit at Hammersmith Hospital (London). During that period, 257 patients were treated.

As an introduction to their clinical discussion, the authors cite the physical data from which they concluded that there is no appreciable difference in biological efficiency between radium gamma rays and the x-rays from the 8-MEV linear accelerator. Preliminary studies showed the erythema dose, after a layer of unit density wax was applied to the skin to insure peak dosage there, to be about 1,000 rads, which approximates the 1,000 r for radium.

Dose distributions within the body for a single field were compared with those for 250-kv x-rays and were found to have the following advantages:

(1) With 8 MEV, the surface dose is low, being only 10 to 25 per cent of the peak dose 2 cm. below the skin. (2) There is less rapid fall-off of dose with increasing depth, as a result partly of the increased focal skin distance (100 cm.) and partly of the higher energy of the radiation, but the exit dose becomes significant. (3) Field size has little influence on depth dose, and there is rapid fall-off of dosage outside the edge of the field, though a considerable penumbra is present due to the 0.5-cm. focal spot and diaphragm system. (4) For a given tumor dose the integral dose is apparently less than with 250 kv, especially for small fields.

In the actual treatment of patients, the tumor is localized by the usual methods and a diagrammatic reconstruction of a transverse body section is made. Fields are set up according to the location of the tumor and checked by radiographs in the exact treatment position. Thus, a tumor extending 6 cm. or less beneath the surface requires only one field. Tumors of the head and neck and of the breast are treated with two fields, which may or may not be opposing. Four fields are usually employed for tumors of the bronchus, esophagus, pituitary, bladder, and pelvis.

The dosage level for squamous-cell carcinoma of the mouth and pharynx is 5,800 rads delivered in six weeks, while for those of the bladder, bronchus, and cervix it is 4,500 rads in four weeks.

In their year of experience, the authors found skin reactions to be slight, occurring only on exit fields or where bolus was purposely placed in the beam. Constitutional upsets were diminished in comparison to those seen in patients undergoing similar therapy with 250 kv.

Fewer fields were needed because of the greater depth dose, and consequently planning and setting up of fields was easier. Determination of the full effect on normal tissue and the true tumor response awaits the passage of time and comparative study.

Ten illustrations; 2 tables.

JAMES NICHOLS, M.D.
Cleveland City Hospital

Rotation Therapy with a 2 MeV Van de Graaff Generator. K. F. Orton. *Brit. J. Radiol.* 29: 186-192, April 1956. (Sheffield National Centre for Radiotherapy, Sheffield, England)

The author commences his discussion with a detailed review of the technical aspects of the installation for rotation therapy at the Sheffield National Centre for Radiotherapy. Important points are a 90 cm. target-axis distance, automatic control to permit treatment over two separate arcs, and provision for cylindrical rotation therapy only.

Preference is given to rotation about the tumor axis, since rotation about the body axis increases the volume of tissue irradiated and results in a 12 per cent greater dose at the periphery of the tumor than at its center. With the former method, the dose variance within the tumor is constant within the limits of ± 2.5 per cent, and at a point 1.5 cm. lateral to the treated volume the dose received is 50 per cent of that received by points within the treated volume. This necessitates very accurate localization, which is accomplished by the use of three skin marks so placed that the tumor axis is collinear with the orthogonal projection of the anterior mark onto the plane containing the two lateral marks. This is achieved by the use of a rectangular box with a 1 cm. radiopaque grid on each side. The patient is placed in the box so that the tumor lies in a vertical plane parallel to the sides of the box. Two radiographs are then taken at right angles, with the images of the two sets of grid wires superimposed on that of the tumor. From the radiographs, the projection of the tumor axis on the box is calculated, and the skin marks are placed on the patient accordingly. The patient is then positioned on the treatment platform with the tumor in the axis of rotation, and the x-ray beam is adjusted to the center of the tumor.

Dosage calculations are based on the fact that dose-rate at any position in a phantom is determined by the distance of the point from the target and the length of path traversed in tissue by the beam. The actual fraction of the incident dose transmitted by a certain thickness of tissue was obtained from measured percentage depth-dose curves. Using these principles a dosage calculator was constructed which allows for rapid calculations. The accuracy of the calculator was checked by experimental measurements, and close agreement was found.

The shape of the dose distribution in planes perpendicular to the axis of rotation was confirmed by photographic methods, which showed the ring of higher dose at the periphery. This may vary by 5 per cent with a field width of 8 cm., due to the fact that the depth dose curve is concave and that the average of the dose-rates at $t + x$ cm. and $t - x$ cm. is greater than the dose-rate at a depth of t cm. Non-uniform tumor dose is also obtained when the center of rotation is asymmetrically placed with respect to the body section.

Ten illustrations; 1 table. JAMES NICHOLS, M.D.
Cleveland City Hospital

Dosage Data for 4,000,000 Volt X Rays. D. Greene and F. W. Tranter. *Brit. J. Radiol.* 29: 193-196, April 1956. (Christie Hospital, Manchester 20, England)

Depth dose data and isodose curves for normal and oblique incidence have been measured by the authors for radiation from a 4-MEV linear accelerator. The F.S.D. used was 100 cm. and the doses and dose rates were monitored by two parallel ion chambers placed in the beam between the flattening filter and the collimator. Depth dose readings were made in a water phantom with a Baldwin "Ionex" dosimeter. Readings were taken at 1 cm. intervals along the central ray and scans were made perpendicular to the beam at intervals of 1 mm. at the edges and 1 cm. inside the beam.

Surface dose was measured by placing the ion chamber on a Presdwood phantom, and readings taken with nothing over the chamber corresponded to a depth of 0.6 mm., the chamber wall thickness. The surface dose was found to be 25 per cent of the maximum, which was measured at a depth of 1 cm. Output measured with an Ionex dosimeter was 120-130 r/min. at 1 meter F.S.D. with a 10×10 -cm. field and a pulse repetition frequency of 350 per second. The variation of dose rate with field size was 10 per cent for a range of areas from 20 to 400 sq. cm.

It was found that depth doses for rectangular fields of elongations up to 3:1 were essentially the same as for square fields of similar areas, and that measurements at different F.S.D.'s and oblique incidences were in agreement with the values calculated from the 100 cm. and normal incidence values by the inverse-square law. These latter phenomena are explained by the forward direction of the scatter and the relative amounts of primary and secondary irradiation at any one point.

Four figures; 2 tables. JAMES NICHOLS, M.D.
Cleveland City Hospital

Dosage Distribution in Rotational Cobalt 60 Therapy. D. E. A. Jones, C. Gregory, and I. Birchall. *Brit. J. Radiol.* 29: 196-201, April 1956. (Mount Vernon Hospital, Northwood, Middlesex, England)

The machine studied by the authors contains a 1,000-curie (cobalt 60) source which can occupy any position on the central zone of a spherical surface of 75 cm. radius, while the axis of the beam always passes through the center of the sphere. The patient rests on a horizontal couch, the long axis of which is parallel to the axis of rotation. Depth dose charts were first calculated in a water phantom, using a 60 cm. source-to-skin distance (S.S.D.), but since this distance varies during rotation because of bodily contours, a method was needed to derive proper dosage from these charts. The following solution was evolved.

The values of percentage depth dose for a given S.S.D. and field area, corrected for inverse-square law attenuation, when plotted on a logarithmic scale against the depth, produced a family of straight-line parallel graphs, such that the slope of the central axis plot provided the "effective absorption coefficient" $\bar{\mu}$. This was calculated from $I_2/I_1 = e^{-\bar{\mu}(d_1-d_2)}$, where $I_1 = I_0(f + d_1)^2/f^2$, and $I_2 = I_0(f + d_2)^2/f^2$, and $f =$ S.S.D., the depths d_1 and d_2 being suitably chosen points on the graph. Therefore in order to compensate for excesses or deficits of tissue from the 60 cm. S.S.D. standard, a multiplying factor, e.g., $e^{-\bar{\mu}d}$ and $e^{+\bar{\mu}d}$ was used, where $d =$ the depth of tissue in excess or deficit.

To obtain dose distribution for a full rotation, 18 fixed positions were used. For any selected point the relative dose was calculated by $\Sigma_1^{18} \rho e^{\pm \bar{\mu}d}$ where $\rho =$ per cent depth dose read off the chart and d is the thickness of tissue deficit or excess. This method was checked by actual measurements in a water phantom, and the isodose charts agreed closely except in regions less than 5 cm. below the skin.

Using these principles the authors illustrate the dosage curves of an eccentrically placed pelvic tumor, showing that the region of maximum dose is displaced only 5 mm. from the axis of rotation and that significant isodose contours vary little from a system of concentric circles. Charts have been calculated for circular cross sections of 30 cm. diameter, which can be superimposed on the cross section of the patient, provided the tumor does not lie too close to the skin.

For more eccentrically located tumors, cycling rotation (*i.e.*, uniform angular to-and-fro rotation over a limited arc) was used and the $\bar{\mu}$ method was employed as a routine, although at times the rotational center was only 5 cm. or less beneath the skin. This is illustrated by the dosage curves for an antral lesion in which the actual S.S.D. averaged 68.5 cm. and the calculated values approximated the experimental readings closely enough for practical purposes. At times the authors check the dosages during treatment by placing an ionization chamber on the skin or in the nearest body cavity. They have also observed that in cycling rotation the region of maximum dosage is significantly displaced away from the rotational center toward the source, and that the area enclosed by the 80 per cent isodose curve has a tendency to become elongated (*a*) along a line through the rotational center bisecting the arc of treatment, for arcs of 100° or less, and (*b*) along a line at right angles to this direction for larger arcs.

In full rotational therapy a correction factor is computed for the absorption by the girders of the couch.

Dosage levels in the third dimension (*i.e.*, parallel to the axis of rotation) showed close enough correlation to the rotation axis dosage to give a reasonably accurate estimate of the entire volume dosage.

Eight figures. JAMES NICHOLS, M.D.
Cleveland City Hospital

The Stray Radiation Levels of a 45 MeV Travelling Wave Linear Electron Accelerator. C. L. Hsieh. *Brit. J. Radiol.* 29: 201-204, April 1956. (Michael Reese Hospital, Chicago, Ill.)

The author points out that stray radiation from an accelerator depends largely on its design. A series of diagrams illustrate the particular installation which was studied. [This has been described in *Radiology* 66: 859, 1956, and 67: 263, 1956.]

Three types of stray radiation were measured: x-rays caused by stray accelerated electrons, neutrons by photodisintegration, and electrons. X-rays were measured with a Victoreen 25-r thimble chamber with a wall thickness of 2.5 cm. Both fast and slow neutrons were measured by the Rh foil activation method, utilizing the 2.3 MEV beta activity of 44 sec. half-life. All readings were made 1 m. above the floor level when the machine was operated at 30 MEV and with a 10×10 cm. field. Readings were normalized to a charge of 3.8×10^3 coulombs/cm.² delivered to the target, which consisted of a tank of water sufficient to absorb the beam completely.

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The results showed that the fast neutrons had a symmetrical distribution around the axis of the downward electron beam. Slow neutron intensities increased toward the walls of the room, indicating that their source was collisions between the fast neutrons and the hydrogen nuclei in the wall. The x-radiation and stray electrons showed a uniform distribution over the electron beam, a sharp cut-off at the beam boundaries, and a low intensity at a greater distance from the beam. Increasing the energy of the output beam from 5 to 35 MEV showed a steadily decreasing amount of x-radiation which was caused by the larger fraction of electrons not bound to the travelling wave and the greater loss of electrons due to lateral instability and scattering at low energies. For neutrons, a rise was seen from 10 to 25 MEV and a decrease beyond, due to a change in resonant energy between copper and carbon. Artificial radioactivity with a composite half-life of thirty-six minutes and insignificant intensity was detected after each run. The radiation in the control room was of the order of 4×10^{-8} r for x-rays, 1×10^{-10} m/cm.² and 0.5×10^{-10} m/cm., respectively, for fast and slow neutrons.

Five figures.

JAMES NICHOLS, M.D.
Cleveland City Hospital

Investigations of Dose Distribution in Grid Therapy in the Phantom and in the Patient. Hans-Jürgen Eichhorn and Siegfried Matschke. *Strahlentherapie* 99: 536-548, April 1956. (In German) (Deutschen Akademie der Wissenschaften Berlin, Institut für Medizin und Biologie, Geschwulstklinik, Berlin, Germany)

The authors measured the effect of a single-position 10×15 -cm. lead-rubber grid with round holes, with 61 per cent of the areas closed, upon depth dose distribution, using ionization chambers and Agfa-Wolfen dosimetry film No. 2. The photographic method showed a more uniform distribution because the film was more sensitive to the softer secondary rays present in the interspaces.

Motion of the patient and shifts in the position of the focal spot do not eradicate the difference between open and closed areas in the depth, as shown by films placed on exit ports.

Two theories of the biological advantages of grid therapy are discussed: (1) The increased tumor dose made possible by the use of the grid explains the good results. (2) The low doses in the interspaces permit

an inflammatory reaction to take place which acts as a defense mechanism against the tumor.

Six figures; 2 tables.

GERHART S. SCHWARZ, M.D.
New York, N. Y.

Depth Doses in Roentgen Grid Irradiation. Karl Seidel. *Strahlentherapie* 99: 549-554, April 1956. (In German) (Röntgen- und Radiumabteilung des Oldenburgischen Landeskrankenhauses Sanderbusch, Oldenburg, Germany)

Depth dose measurements are presented indicating that at a depth of 16 cm. there is still a ratio of 1:1.75 between open and closed areas when a round-hole, 60 per cent closed grid is used. Comparison with homogeneous beams as to the maximum attainable depth dose is made on the basis that the skin tolerance is five times higher when a grid is used. This assumption is deduced from published work of others. The author does not report any personal clinical experiences with grid therapy.

[There is mounting evidence that the safe skin dose in grid therapy is much smaller than first thought and that the ratio of 1:5 will have to be revised.—G. S. S.]

One graph; 2 tables. GERHART S. SCHWARZ, M.D.
New York, N. Y.

The Flux of Secondary Ionizing Particles in a Uniformly Irradiated Homogeneous Medium of Varying Density: Application to Walled Ionization Chambers. G. Failla. *Radiation Res.* 4: 102-109, February 1956. (Radiological Research Laboratory, 630 W. 168th St., New York 32, N. Y.)

The practical applications of this paper have to do with the construction of tissue-equivalent and air-equivalent ionization chambers. The author states that in principle air-equivalent or tissue-equivalent ionization chambers of any size and shape may be built. In practice, non-uniformity of the primary radiation field usually limits the size. A more important factor, however, is the difficulty of providing walls and gas of the desired atomic composition. In the case of air there is no solid material with this composition. Therefore, walled chambers are never truly air-equivalent. Close approximation may be obtained by proper design. A few points illustrating the underlying principles are discussed.

RADIOISOTOPES

A Study of the Uptake of Iodine (I-131) by the Thyroid of Premature Infants. Edgar E. Martmer, Kenneth E. Corrigan, Harold P. Charbeneau, and Allen Sosin. *Pediatrics* 17: 503-509, April 1956. (E. E. M., 10 Peterboro, Detroit 1, Mich.)

The authors describe a method of determining the uptake of I^{131} in infants twenty-four hours following the administration of 5 mc. orally or by means of a polyethylene tube in the stomach. Measurements were made by both a Geiger-Müller counter and a scintillation counter.

In a series of 65 premature infants weighing from 991 to 2,481 gm. and 5 full-term infants of 2,522 to 2,694 gm., from one to sixty-three days old, the I^{131} uptake ranged from 10 to 60 per cent. In 2 cases with uptake of less than 10 per cent and 3 cases bordering 60 per

cent, technicalities and the possible surreptitious use of thyroid by the mother may account for the variations.

The range of uptake of I^{131} as recorded in this series is within the limits of normal as determined in children and adults with the Geiger-Müller counter. The difference in percentage uptake as recorded by the Geiger-Müller counter and the scintillation counter, after experience with the equipment, was less than 5 per cent.

One photograph; 4 tables. ALVIN SEGEL, M.D.
Cleveland City Hospital

Salivary and Thyroidal Radioiodide Clearances of Plasma in Various States of Thyroid Function. Karl Fellingner, Rudolph Höfer, and Herbert Vetter, with the technical assistance of Gertrude Wüstinger. *J. Clin.*

Endocrinol. & Metab. 16: 449-462, April 1956. (Radioisotopes Laboratory, Second Medical University Clinic, University of Vienna, Vienna, Austria)

Thode et al., in a recent study of salivary-gland and thyroid-gland function with radioiodine (New England J. Med. 251: 129, 1954. Abst. in Radiology 64: 792, 1955) concluded that "a definite relationship exists between thyroid and submaxillary gland function" and that "the submaxillary gland not only concentrates iodide ion, but is concerned with thyroxine as well, perhaps in its deiodination."

The authors tested the validity of this conclusion by comparing the clearance rates of radioiodide from plasma by the thyroid and salivary glands in a number of patients with varying degrees of thyroid function. Twenty-three subjects were studied, though not all were used in any one phase of the investigation. Thyroid function was evaluated by means of clinical observations and various laboratory tests, including three different radioiodide tests: the twenty-four-hour thyroidal uptake, the concentration of serum protein-bound I^{131} in a forty-eight-hour plasma sample, and the so-called "radioiodine plasma test." The thyroidal plasma iodide clearance rate was calculated from thyroid uptake data and the plasma radioiodide concentration. Beginning three minutes after intravenous injection of the tracer dose, several blood samples were drawn and frequent measurements of the neck radioactivity were made for the following two hours. Evidence of radioactivity over the thyroid at three minutes was assumed to represent extrathyroidal radioiodide concentration in the blood and in neck tissues; this value was used to correct thyroid uptake data to obtain "true thyroid uptake," the actual correction factor used being proportional to the constantly decreasing plasma radioiodide concentration. The direct clearance rate of the thyroid was expressed as milliliters cleared per minute.

The concentration of radioiodide in serous saliva obtained by catheterization of the right or left parotid duct was used in a similar fashion to calculate the salivary clearance rate of plasma radioiodide in milliliters cleared per minute. The radioiodide concentration of mixed saliva (serous + mucous) was also determined.

It was observed, during these experiments, that the thyroidal radioiodide clearance rate showed a significant decrease in the first ninety minutes following the administration of the dose.

The influence of the rate of salivary flow upon the salivary concentration of radioiodide was investigated with and without stimulation of salivary flow by pilocarpine.

The authors concluded that the ratio of salivary to plasma radioiodide concentration is apparently determined by the plasma concentrations of radioiodide and protein-bound radioiodine and reflects thyroidal function only in so far as do the plasma concentrations. In addition to all the factors which determine the plasma concentration, the saliva-plasma ratio is influenced by the rate of salivary flow and by the extent of dilution of serous by mucous saliva. In contrast to the salivary radioiodide clearance, the thyroidal radioiodide clearance was found to decrease significantly during the early phase of iodide distribution. This observation can be explained by the hypothesis that thyroidal uptake is a two-way function with (in normal cases) the rate of iodide binding being slower than the rate of iodide trapping.

The results of the present experiments are not considered to support the view that thyroid and submaxillary gland functions are related to each other.

Four graphs; 4 tables. JAMES E. BAUER, M.D.
University of Missouri

Hyperthyroidism Treated with Radioiodine. A Seven-Year Experience. William H. Beierwaltes and Philip C. Johnson. Arch. Int. Med. 97: 393-402, April 1956. (Department of Internal Medicine, University of Michigan Medical School, Ann Arbor, Mich.)

A study is reported in which 330 patients were given one or more treatment doses of radioactive iodine from Feb. 24, 1948 to Jan. 1, 1955, in an attempt to cure thyrotoxicosis with a single dose. Eighty-two of the patients had nodular toxic goiter, and the remainder exophthalmic goiter (non-nodular). Indications for treatment included persistence or recurrence of thyrotoxicosis after a previous thyroidectomy, refusal of surgery by patient or surgeon, an age level over forty years, drug reaction, serious eye signs, decreased life expectancy, preoperative preparation requiring more than four months. It is noted that the incidence of complications given is distorted, an effort having been made particularly to select such patients for therapy.

In attempting to cure thyrotoxicosis with a single administration of radioactive iodine, the incidence of persistence or recurrence of the condition resulting from undertreatment must be balanced against the incidence of temporary or permanent hypothyroidism caused by overtreatment. An average of 36 per cent of patients with toxic nodular goiter and 20 per cent of those with non-nodular goiter had persistent or recurrent hyperthyroidism after one dose. Temporary or permanent hypothyroidism was induced in the same percentage (20) of patients with exophthalmic goiter, but in only 10 per cent of those with toxic nodular goiter. It was also observed that with nodular goiters a larger dose was required to render the patient euthyroid than with exophthalmic goiters of comparable size and that resolution of nodular goiter was much less common than resolution of exophthalmic goiter. In view of these findings, the authors no longer attempt to cure nodular toxic goiters with a single dose.

In no instance of substernal goiter was reduction in tracheal distortion seen roentgenographically, nor was shrinkage in size noted during treatment with I^{131} , even when the coexistent visible neck goiter was decreased in volume by as much as 60 per cent.

Contrary to the authors' initial expectations, patients with exophthalmic goiter persistent or recurrent after a previous thyroidectomy require a larger average total dose for relief of thyrotoxicosis than patients with exophthalmic goiter not previously treated surgically. On the other hand, patients with persistent or recurrent nodular goiter required a smaller dose than those with toxic nodular goiter undergoing no surgery.

In 5 per cent of the patients minor symptoms of irradiation-induced thyroiditis developed. No deaths from thyroid crisis were recorded. In 7 patients with toxic nodular goiter and 1 with exophthalmic goiter, subsequent surgery was required because of goiter persistent after relief of thyrotoxicosis. Of these operative specimens, in addition to five thyroids examined at autopsy (all previously given radioiodine), only one exhibited morphologic changes generally attributed to I^{131} . In no instance was carcinoma found.

Ten tables.

Vol. 68

The Modern Treatment of Thyrotoxicosis. George J. Hamwi and Robert F. Goldberg. *Arch. Int. Med.* 97: 453-465, April 1956. (Department of Medicine, Ohio State University, Columbus 10, Ohio)

The current methods of treatment of thyrotoxicosis are reviewed. The selection depends on the type of disease, the age and general physical condition of the patient, and the availability of the different forms of therapy.

In most cases of diffuse toxic goiter, radioactive iodine is the treatment of choice; surgical morbidity is avoided and aggravation of exophthalmos is probably less apt to occur. The possibility of malignant thyroid disease resulting from I^{131} therapy is regarded as unlikely. Pregnant patients are treated with antithyroid drugs and desiccated thyroid until after the postpartum stage. Prepubertal children and adolescents are best treated by subtotal thyroidectomy.

In toxic nodular goiter, treatment has generally consisted of subtotal thyroidectomy. The response of this condition to I^{131} is less predictable and larger doses than those given to diffuse goiters are ordinarily required. In some cases treated with radioactive iodine, however, the response is satisfactory. If another disease is present, increasing the risk of surgical morbidity, radioactive iodine is to be preferred. I^{131} has been found to be a satisfactory means of preparing patients for thyroidectomy, occasionally eliminating the need for surgery altogether. Solitary toxic nodules are particularly apt to respond favorably to I^{131} .

In recurrent thyrotoxicosis following subtotal thyroidectomy radioactive iodine is the treatment of choice, as it avoids the increased technical difficulties of re-operation with the associated increased morbidity.

The palliative effect of I^{131} in euthyroid cardiac patients is briefly discussed.

Two radioautographs; 2 tables.

Serum I^{131} Fractionation in Metastatic Carcinoma of the Thyroid. The Fate of Endogenous Radiothyroxine after I^{131} Therapy. Manuel Tubis and Franz K. Bauer, with the technical assistance of H. Bruce Thomas and Vivian E. Anderson. *Cancer* 8: 1115-1121, November-December 1955. (Radioisotope Unit, Wadsworth Hospital, VA Center, Los Angeles, Calif.)

Six athyreotic patients with metastatic thyroid carcinoma were given therapeutic amounts of I^{131} (25 to 100 mc per dose), preceded by injections of thyroid-stimulating hormone (TSH). The metastases were demonstrated by scintigrams. Plasma samples were fractionated serially after each dose, and the endogenous radiothyroxine measured quantitatively. Endogenous radiothyroxine was found in significant amounts after the first few therapeutic doses. During the course of therapy, endogenous radiothyroxine production by the metastases became inhibited, but metastatic lesions could still be demonstrated scintigraphically.

The authors believe that in patients with metastatic thyroid carcinoma larger doses of I^{131} (in excess of 100 mc per dose) should be given, since the amounts used in the present series appear to inhibit thyroxine production without interfering with the iodine-accumulating mechanism.

Four scintigrams; 4 tables.

Experiences with Radioactive Chromic Phosphate in Urological Tumors. Vincent Moore, Dean Gamble, and Raymond L. Libby. *Arch. Surg.* 72: 464-468, March

1956. (Wadsworth General Hospital, VA Center, Los Angeles, Calif.)

The authors undertook to determine whether a pure beta-emitting isotope, interstitially injected, would be effective in the treatment of advanced urological tumors, without serious damage to surrounding normal tissue. Chromic phosphate ($CrPO_4$), containing radioactive phosphorus, was selected for the study. An electrically driven and electronically controlled injector was used, permitting the introduction of exact, predetermined volumes of the isotope solution. The nominal dose was 100 μ c in 0.1 ml. volume for each gram of tumor tissue; this dose will theoretically deliver 88,500 equivalent roentgens to each gram of tumor tissue around it.

Palliative therapy of advanced, surgically incurable bladder and prostatic cancer was begun in March 1953; 45 patients were treated, 4 of whom were given repeat injections. Autopsies were obtained in 14 of 19 fatal cases.

In 4 cases of bladder cancer, transurethral biopsies showed benign tissue in areas of previous deep carcinoma; in 7 cases of advanced prostatic cancer there was no evidence of tumor tissue at biopsy sites; in other instances, marked cytologic changes were apparent in the areas of injection. Liver tests, bone marrow assays, and blood counts failed to demonstrate damage after interstitial injection.

Improved distribution of interstitially injected isotopes is regarded as the most fundamental problem yet to be solved.

Four photomicrographs; 3 photographs; 2 diagrams.

A Histopathological Study of Lymph Nodes Irradiated with Colloidal Au^{198} . William M. Christopherson and Harold F. Berg. *Cancer* 8: 1261-1269, November-December 1955. (Departments of Pathology and Surgery, University of Louisville School of Medicine, Louisville, Ky.)

A histopathological study was made of 377 lymph nodes irradiated by injecting radiogold, Au^{198} , into the afferent lymphatics. Autoradiograms were prepared to determine the intranodal distribution of the isotope.

The intranodal changes varied considerably and were dependent on the length of irradiation exposure, the magnitude of the radioactivity used, and the proximity of the injection site to the lymph nodes. The changes differed quantitatively but not qualitatively from those found in nodes irradiated by other methods. The intranodal distribution and radiation change were usually of a patchy nature. Only when large dosages—50 to 85 mc—were employed was there a tendency toward total or near-total node destruction. This amount of radioactivity was not tolerated well at the site of injection.

The inability to control the distribution of the isotope within the regional lymph nodes would appear to be a major obstacle to the effectiveness of this method of delivering selective ionizing radiations.

Twenty-three figures.

Blood Volume Determinations with Radioactive Chromium (Cr^{51}) Labeled Erythrocytes. Feasibility of Routine Total Red Blood Cell Volume Determinations in a General Hospital. Leo M. Meyer. *J.A.M.A.* 160: 1312-1315, April 14, 1956. (43 S. Lewis Pl., Rockville Centre, N. Y.)

The author describes in detail the use of radioactive

chromium (Cr^{51}) for tagging erythrocytes for determination of blood volume. This method is thought to be much more accurate than a hematocrit determination from peripheral venous blood. The determination of the radioactivity of the stool serves also to show whether

bleeding from the gastrointestinal tract is present, since any bleeding would contain some of the red cells tagged with radioactive chromium (Cr^{51}).

Seven tables.

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RADIATION EFFECTS

IN MAN

Damage to the Intrauterine Fetus by Roentgen Rays. Marko Bašić and Danica Weber. *Strahlentherapie* 99: 628-634, April 1956. (In German) (Allgemeinen Krankenhauses "Dr. Stojanovic," Zagreb, Yugoslavia)

This report concerns a girl, born in February 1951, at full term, to a forty-year-old mother who had received radiotherapy for castration in the fourth month of her unrecognized pregnancy.

The mother was known to have had a left mastectomy for carcinoma in 1950, followed by skin metastases. Three months later roentgen sterilization was undertaken, 600 r being delivered to each of two anterior 10 X 15-cm. pelvic ports and 300 r to a 24 X 24-cm. posterior pelvic port (180 kv, 0.5 mm. Cu filtration). Shortly thereafter pregnancy was diagnosed, but abortion was refused because of the advanced stage of the fetus. Death from metastatic carcinoma occurred in the early post-partum period.

In December 1953 the child was seen in the Pediatric Division because of retardation. The published photographs show a relative atrophy of the lower extremities and areas of cutaneous depigmentation alternating with those of hyperpigmentation. An encephalogram demonstrated external hydrocephalus, porencephaly, and microcephaly; the epiphyseal development indicated an age of one and a half to two years, the general physical appearance an age of twelve to sixteen months, whereas the actual age was three years. Psychometric tests revealed complete idiocy.

The literature on 168 similar cases [many of them probably duplications] is reviewed. Lesions produced by irradiation of a four- to five-month human fetus are identical with those produced in the mouse 10.5 days after conception. In one series reviewed, 79 per cent of the abnormal infants had been irradiated before the fifth month of prenatal life. In another series the incidence of damage was 100 per cent in those irradiated in the first two months of pregnancy, 64 per cent in those irradiated in the third to fifth month, and 23 per cent in the sixth to tenth month. Therapeutic abortion is definitely indicated, since in 34 per cent of all cases severe abnormalities occurred without resulting in spontaneous abortion.

[The abstractor's estimate of the dose to the fetus in the case reported was 500 to 600 r (in two sessions), with a narrow mid-line overlap zone of about 900 to 1000 r.]

Four roentgenograms; 2 photographs.

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Granulosa Cell Tumor Producing Symptoms Four Years Following Radium Menopause. David M. W. Maxwell. *J. Obst. & Gynaec. Brit. Emp.* 63: 232-233, April 1956. (Canadian Red Cross Memorial Hospital, Taplow, Bucks, England)

The author reviews various reports in the literature

of estrogenic tumors growing and causing symptoms after pelvic irradiation by radium or deep x-rays. He reports a case in which a granulosa-cell tumor produced uterine bleeding and was discovered on examination approximately five years following a radium-induced menopause. Pathological examination of the surgical specimen revealed a granulosa-cell tumor of the right ovary and cystic glandular hyperplasia of the endometrium.

Two photomicrographs. JAMES E. BAUER, M.D.
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Aftercare Following Intraluminal Cobalt Therapy for Carcinoma of the Bladder. Robert Erich Schick. *Strahlentherapie* 99: 510-519, April 1956. (In German) (Czerny-Krankenhaus für Strahlenbehandlung der Universität Heidelberg, Heidelberg, Germany)

More than 300 carcinomas of the urinary bladder have been treated at the author's institution by radioactive cobalt applied endovesically (cobalt pearls or a liquid suspension). With this form of therapy the mucosal reaction is very severe, resembling the skin reaction to external irradiation. Edema, exudative fibrous inflammation, ulceration, and necrosis are added to a pre-existent cystitis caused by the carcinoma.

Measures to reduce the cystitis are described. Various materials for irrigation are recommended, including antibiotics. Use of the cautery is contraindicated. Treatment of hemorrhage depends upon whether it is early or late (one to two years after treatment). Symptomatic measures are important, and numerous drugs are mentioned for relief of pain, tenesmus, and insomnia, and for increasing the capacity of the bladder. Many of them are proprietary preparations with names unfamiliar in this country.

The diagnosis and treatment of recurrences are briefly discussed.

The general conclusion to be drawn is that the success of radiation treatment of carcinoma of the bladder lies largely in the hygienic measures that follow.

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PROTECTION

Radiological Defense Plans in California. Stafford L. Warren and Justin J. Stein. *J.A.M.A.* 160: 1215-1218, April 7, 1956. (J. J. S., 17-044 Cancer Research Wing, Medical Center, Los Angeles 24, Calif.)

The need for an organized plan for radiological defense is stressed and an outline of California's present civil defense plan is presented. The function of the plan for the pre-emergency period, during the emergency, and in respect to long-range radioactive contamination problems is considered. The program includes the training of citizens as monitors, laboratory technicians, and instructors, the purchase and maintenance of necessary laboratory equipment for radiologic assay,

the organization of monitoring squads, and the design and purchase of mobile laboratories. Most of the equipment has been concentrated away from critical target areas.

In this plan it is assumed that most radiologists will be working with their assigned medical team or in fixed or improvised hospitals. Those trained in radiation therapy will be used to form evaluation teams, which will be composed of a radiologist, a physicist, a soil scientist, a biologist, and a meteorologist.

Permissible exposures for monitors are listed as: first day, 25 r; second day, 10 r (acute period); third to fifth day, 3.3 r per day (intermediate period); sixth through fifty-sixth day, 0.1 r per day (later period); a total of 50.0 r. After the fifty-sixth day, the present acceptance tolerance level of 0.3 r per week is applicable. The problems of decontamination of patients and personnel are described.

The authors stress that the public should be given complete non-secret information about thermonuclear weapons, since adequate knowledge of this subject would be helpful in decreasing the number of casualties. The availability of an evacuation plan to be used in the pre-attack period is deemed most important.

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EXPERIMENTAL STUDIES

Radiation as a Carcinogenic Agent. Austin M. Brues. *Radiation Res.* 3: 272-280, November 1955. (Division of Biological and Medical Research, Argonne National Laboratory, Lemont, Ill.)

The author has reviewed current knowledge concerning the mechanism of radiation carcinogenesis from the standpoint of its possible bearing on human carcinogenesis at low levels of radiation. His conclusions are as follows:

In a few cases, notably lymphomas and ovarian tumors in mice, it is obvious that the response is indirect and works through a physiological mechanism involving more than the irradiated cell. These instances show the greatest variation between species.

Although local irradiation yields tumors in the directly irradiated area, an indirect mechanism is also apparent, in that there is a considerable latent period during which successive tissue changes take place, leading eventually to autonomous tumor growth. The latent period is probably related to the life span of a given species.

Present evidence indicates that intense local irradiation is somewhat wasteful of the energy involved, with respect to cancer production. This has not been satisfactorily tested at low dosage levels.

A single irradiation can be effective, but good evidence as to the effect of dividing doses is lacking. The influence of ion density and dose-response relationships, although partly understood, requires further investigation.

Some difficulties with the somatic mutation theory are discussed. Although a cellular mutation may be one necessary step in tumor formation after irradiation, the present evidence suggests that it must play a subordinate role.

Lethal Effects on Rats of Single and Multiple Exposures of 400-Kv and 22-Mv X-Radiation. W. S. Moos, J. B. Fuller, W. J. Henderson, F. Dallenbach,

and R. A. Harvey. *Radiation Res.* 3: 44-51, September 1955. (W. S. M., 840 S. Wood St., Chicago 12, Ill.)

The purpose of the experiments described in the present report was to compare the lethal response of rats to single and multiple exposures of 400-kv and 22-MV x-radiation. Weights and gross pathologic findings are recorded, but histologic findings are to be reported elsewhere.

Irradiation of rats with single doses of 400-kvp and 22-MV x-irradiation showed that the latter is only about 75 per cent as effective as the 400-kv x-rays when based on the LD 50/30.

When rats were irradiated with fractionated exposures of 51 r/day, the lethal effectiveness of 22-MV x-rays (based on accumulated exposure at the time 50 per cent of the animals had died) was only 55 to 60 per cent of that of the 400-kv radiation. This may be due to the lower effectiveness of the daily exposure (51 r) of 22-MV x-rays, which permitted greater recovery.

Calculation of integral dose showed that delivered by 22-MV x-rays to be about 106 per cent of the 400-kvp dose. Thus, the greater effectiveness of the 400-kv radiation cannot be explained on the basis of dose distribution in the animals.

Gross pathologic examinations were not conclusive in respect to disclosing any different response to the two types of radiation. Pulmonary hemorrhages and pneumonia were predominant as the cause of death in both animal groups.

The effectiveness of the 22-MV x-rays as determined in the present experiment agrees, at least roughly, with that found by Quastler for mice (*Am. J. Roentgenol.* 63: 566, 1950) and by Haas *et al.* for rabbits in single exposures and for tumor therapy over a five-week period (*Am. J. Roentgenol.* 68: 644, 1952. *Abst. in Radiology* 61: 312, 1953).

Three graphs; 1 table.

Reticulum-Cell Sarcoma of Rats. Apparent Inhibition by X Irradiation. David V. Brown and Theodore A. Thorson. *J. Nat. Cancer Inst.* 16: 1197-1205, April 1956.

Having determined that the prolonged subcutaneous injection of dilute solutions of trypan blue produced reticulum-cell sarcoma in rats (*J. Nat. Cancer Inst.* 16: 1181, 1956), the authors investigated the effect of whole-body pre-irradiation on the development of these dye-induced tumors. They were particularly interested in evaluating the effect of administering trypan blue to the rats during the period of active regeneration following irradiation destruction of lymphoid tissue.

The first group of 35 Wistar rats received 400 r of total-body irradiation seven days prior to the subcutaneous injection of 1 c.c. of a 1 per cent solution of the dye. In none of them did reticulum-cell sarcoma develop, but 44 per cent of the 25 animals that survived for two hundred and fifty days had breast tumors. Reports of breast tumor following chronic irradiation are numerous, but the significance of this observation as to the relation between irradiation and trypan blue is unknown.

A second group of 30 rats were treated with dye only, and 23 per cent of the 26 which survived for two hundred and fifty days showed reticulum-cell sarcoma. In only 1 did a breast adenocarcinoma appear.

The authors conclude that irradiation may modify the reticulum cells in such a way that they do not re-

spond to trypan blue in the established fashion. The nature of the alteration is unknown.

Seven photomicrographs; 2 photographs; 1 table.

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Influence of X-Ray on Oxygen Consumption of Spleen and Thymus Glands of Rats. Maurice F. Sullivan and Kenneth P. DuBois. *Radiation Res.* 3: 202-209, October 1955. (U. S. Air Force Radiation Laboratory and Department of Pharmacology, University of Chicago, Chicago, Ill.)

To ascertain the effects of whole-body x-irradiation on the endogenous respiration of spleen and thymus glands, rats were given 400 r and sacrificed at various intervals after exposure. Manometric estimations of the oxygen consumption by slices of the spleens and thymus glands were made. A marked reduction in the endogenous Q_{O_2} for both tissues was observed. Maximal inhibition was noted at forty-eight hours following irradiation, after which time gradual reversal of the inhibitory effect occurred. The endogenous respiration of the irradiated tissues declined more rapidly than that of normal tissues when the incubation period was extended. This indicated more rapid depletion of oxidizable substrates in the slices of irradiated spleens and thymus glands. Addition of glucose, pyruvate, oxalacetate, α -ketoglutarate, glutamate, succinate, fumarate, or malate did not alleviate the radiation-induced inhibition of respiration.

Two graphs; 2 tables.

On the Direct and Indirect Effects of X-Rays on the Testis of the Rat. Henry I. Kohn. *Radiation Res.* 3: 153-156, October 1955. (Radiological Laboratory, University of California School of Medicine, San Francisco, Calif.)

Changes in the weight and histologic appearance of the rat testis were studied after exposure to x-rays. The testes were irradiated locally, with the rest of the body shielded, or along with the entire body. The tissue doses were 60, 180, and 210 r. Such doses delivered to the testis produced losses in weight at thirty-five and forty-five days after exposure. If abscopal (indirect) mechanisms contributed to weight loss, their effects were small. The histologic changes paralleled those in weight. Even cursory examination after 180 or 210 r revealed the marked depopulation of the germinal epithelium that was to be expected from the descriptions of histologic changes by earlier investigators. The dose received by the rest of the body had little if any effect on the testis.

One table.

The Reaction of the Mouse Spleen to X-Rays Measured by Changes in Organ Weight. Robert F. Kallman and Henry I. Kohn. *Radiation Res.* 3: 77-87, September 1955. (Radiological Laboratory, University of California School of Medicine, San Francisco, Calif.)

In order to study the relative biological effectiveness (RBE) of various qualities of radiation, two criteria must be satisfied. First, the doses delivered must be capable of accurate physical evaluation; second, the biological end-point used must be quantitative and reproducible. To gain the most knowledge about the RBE, it is desirable to use biologic end-points covering a wide variety of responses, including those of the whole

organism and of individual organs, tissues, and cells.

The Los Alamos group has reported that splenic weight five days after total-body irradiation of young Carworth Farms mice is a linear function of the logarithm of radiation dose between approximately 50 and 1,000 r, and it has been recommended that the response thus measured be used to determine the RBE of various kinds of radiation. Before employing this method for the determination of the RBE of 1- and 70-MV x-rays, it was thought of interest to examine it critically and to compare the findings with those obtained by the authors for the thymus (*Radiation Res.* 2: 280, 1955) and testis (*Brit. J. Radiol.* 27: 586, 1954).

With mice fifty to sixty days old, the acute involution of the spleen after total-body exposure to 250-kv constant potential x-rays was measured by changes in the organ weight. Changes in dry weight paralleled those in fresh weight. Decreased food consumption *per se* could account for half the splenic weight loss after 400-r total-body irradiation. The time required to reach minimum splenic weight varied from one day after a dose of 30 r to five days after 800 r. The spleen lost weight somewhat more rapidly than the thymus.

Splenic weight determined at five days after irradiation was treated as a linear function of the logarithm of radiation dose, but the data of two out of five experiments showed significant deviations from linearity. Curves based entirely on fifth-day weights were not a true measure of radiation injury, since some recovery had occurred at doses below 400 r. The dose for 50 per cent weight loss was 275 r. The slope and intercept of the fifth-day dose-effect curve fitted to the pooled data of five experiments confirmed quantitatively the results of the Los Alamos group.

Minimum post-irradiation splenic weight was a curvilinear function of radiation dose. The data were fitted approximately by an equation involving the sum of two exponential functions. The dose for 50 per cent weight loss was 177 r. Although providing a statistically acceptable fit in two experiments, the equation was considered provisional.

Methods for determining the RBE of different radiations, with splenic, thymic, and testicular weight loss as the biologic end-point, were compared. It was concluded that the testicular method is the best, and that the thymic method is somewhat better than the splenic.

Two graphs; 4 tables.

Studies on Bone Marrow Lipid in Normal and Irradiated Rabbits. Frederick Bernheim, Athos Ottolenghi, and Karl M. Wilbur. *Radiation Res.* 4: 132-138, February 1956. (Department of Physiology and Pharmacology and Department of Zoology, Duke University, Durham, N. C.)

Fatty acid peroxides are formed when liver, kidney, and brain homogenates or slices are incubated aerobically. The peroxides inhibit certain mitochondrial enzymes; the inhibition is prevented by previous addition of glutathione but only partially reversed by it. Peroxides react slowly with enzymes *in vitro*, and when small amounts are injected into animals, death occurs in twenty to forty hours, depending on the dosage. In the present study peroxide formation was investigated in normal, actively dividing bone marrow and in the marrow of x-irradiated animals. The peroxides were estimated by the thiobarbituric acid reagent.

It was found that rabbit bone marrow homogenates,

unlike those of liver, kidney, and brain, do not produce fatty acid peroxides when incubated *in vitro*. Marrow extracts inhibit peroxide formation in liver homogenates.

Marrow extracts were also found to protect succinoxidase against inhibition by fatty acid peroxides. This effect is apparently dependent on the sulfhydryl content of the extract.

Forty-eight hours after exposure of the rabbit to 1,400 r, marrow homogenates produce peroxides when incubated *in vitro*. They also have measurable amounts of peroxides in the fat fraction before incubation. Extracts from rabbits exposed to 800 r are less effective than those from unirradiated animals in protecting succinoxidase against peroxides.

A significant increase in linoleic, linolenic, and total fat was observed in the marrow of irradiated animals.

Vitamins K, A, and E inhibit peroxide formation in liver homogenates but do not protect succinoxidase against inhibition by peroxides.

Three graphs; 3 tables.

The Incidence of Endogenous Bacteremia in X-Irradiated Rabbits. Carolyn W. Hammond and C. Phillip Miller. *Radiation Res.* 3: 191-201, October 1955. (Department of Medicine, University of Chicago, Chicago, Ill.)

Daily blood cultures were made on 71 young adult (smuffle-free) rabbits beginning on the fourth to sixth day after exposure to 900 r total-body x-irradiation and continuing to the fifteenth to twentieth day on those which survived. Forty-four animals had a total of 238 blood cultures, all negative. Of these 44 animals, 28 (63 per cent) died. Twenty-seven rabbits had a total of 145 serial blood cultures, 39 of which were positive and 106 negative. Of these 27 animals, 81 per cent died. In 14 of the 27 the results of the serial blood cultures were confirmed postmortem. The positive blood cultures never contained more than a few microorganisms.

Of 48 rabbits sacrificed between the fourth and thirty-fifth days (the majority during the second week) post-irradiation, only 2 had positive blood cultures, but 21 had positive cultures of liver and/or spleen, a finding which suggests that these components of the reticulo-endothelial system had been active in removing bacteria from the circulating blood.

All the bacteria recovered ante- or postmortem were members of the rabbit's normal intestinal flora.

No evidence was encountered that bacteremia in the irradiated rabbit progresses to an overwhelming sepsis, as it does in the mouse.

The authors conclude that the irradiated rabbit is able to combat endogenous infection more effectively than the mouse.

Five tables.

Protective Action of Carbon Monoxide in Mammalian Whole-Body X-Irradiation. Eugene B. Konecni, William F. Taylor, and Syreel S. Wilks. *Radiation Res.* 3: 157-165, October 1955. (USAF School of Aviation Medicine, Randolph Field, Texas)

Previous studies by the authors showed that protection from hypoxia significantly increases survival time of guinea-pigs at all radiation doses tested, from 500 to 8,000 r. Since carbon monoxide creates a condition of hypoxia, the present investigation was designed

to obtain general information about the effect of that gas when given before and/or after x-irradiation.

Whole-body x-irradiated guinea-pigs, rats, and rabbits were tested with carbon monoxide in a variety of experiments. Carbon monoxide was administered either by inhalation of 0.10 per cent CO or by intraperitoneal injection of 100 per cent CO. Survival time of animals treated with CO before and/or after x-irradiation was significantly longer ($P < 0.01$) than of irradiated controls. Untreated guinea-pigs given 500 r (LD 100/30) died, whereas 50 per cent of the guinea-pigs receiving CO before and after this dose, and 15 per cent of those treated only afterward, survived the thirty-day test period. This difference in percentage of survival is significant ($P < 0.05$).

The increase in survival time due to pre-irradiation administration of CO is not surprising, since it can be explained as hypoxia. However, at present there is no explanation for the slight though significant protection afforded by carbon monoxide when given up to forty-five minutes after irradiation.

Four tables.

Effects of Acute X-Irradiation on the Evoked Cerebellar Response. John C. Lee, Skuli Helgason, and Ray S. Snider. *Radiation Res.* 3: 267-271, November 1955. (Department of Anatomy, Northwestern University, Chicago, Ill.)

The authors describe an attempt to use electrophysiological methods to evaluate acute radiation damage to the central nervous system. The evoked response resulting from peripheral nerve excitation is a constant feature of cerebellar activity, and alterations of its amplitude or wave form should be an indication of acute damage induced by irradiation.

The evoked neurological response of the cerebellum was recorded in cats while the animals were being irradiated with 220-kv x-rays at rates of 50 to 120 r/min. The amplitude of the response began to decrease at an average value of 6,000 r but varied within a range of 1,500 r on either side of this figure. Animals receiving more than 10,000 r showed severe flattening of the response. Both the primary response and the after-discharge were affected by irradiation. Responses reduced during exposure to radiation showed a further reduction in the early (ten to thirty minutes) post-irradiation period.

Two figures.

Comparison of Biological Effects of Whole-Body Irradiation with 22.5-Mev X-Rays, 18-Mev Electrons, and 400-Kev X-Rays in the Rat. John B. Fuller, Irene Chen, John S. Laughlin, and Roger A. Harvey. *Radiation Res.* 3: 423-434, December 1955. (Departments of Radiology and Pathology, University of Illinois, College of Medicine, Chicago, Ill.)

The experiments reported here were planned to compare the effects of high-energy betatron irradiations with those of lower energy from a conventional 400-kev peak therapy machine under conditions where the differences in depth dose distribution were eliminated. The main objective was to ascertain whether any qualitative differences exist between the effects of the high- and low-energy radiations. The second objective was to find out how the ratios of efficiency (quantitative differences) of the high- and low-energy irradiations compared for several different reactions: the thirty-day LD 50 for the high- and low-energy radiations, time

of death with a single dose treatment, and comparative clinical data and body weight change of high- and low-energy treated groups.

Young male albino rats of the Sprague-Dawley strain were used in the investigation. One experiment compared the effects of single whole-body exposures of 18-MEV electrons and 400-kev peak x-rays. The second was then carried out to determine the LD 50/30 of the 22.5-MEV peak x-rays versus the 400-kev peak x-rays.

No qualitative differences in responsiveness to the high- and low-energy radiations was observed.

Consistent quantitative differences in responsiveness to the high- and low-energy radiations in the same region of magnitude as noted by others were found.

An immediate mechanism causing death during the period from three to ten days postirradiation was gastrointestinal injury. A second, delayed mechanism causing death from twelve to twenty-two days postirradiation was the result of injury to the hematopoietic system. Deaths resulting from these two mechanisms were distinctly separated in time. These mortality-time patterns were very similar in the two treatment groups being compared. For these reasons, the post-weanling rat is a particularly good experimental subject for total-body irradiation and comparisons of effects of high- and low-energies.

Four graphs, 4 tables.

The Relative Biological Effectiveness of Fast Neutrons, X-Rays, and γ -Rays for Acute Lethality in Mice. A. C. Upton, F. P. Conte, G. S. Hurst, and W. A. Mills. *Radiation Res.* 4: 117-131, February 1956. (Biology Division and Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tenn.)

It has long been accepted that the biological effects of ionizing radiations depend on the energy associated with the ionization they produce in living matter. Furthermore, since the pioneer studies of Zirkle (*Am. J. Cancer* 23: 558, 1935), it has been recognized that biological effectiveness is a function not merely of the number of ions produced but also of the ion density along the track of the impinging radiation. Lawrence and his associates (*Proc. Nat. Acad. Sc. U. S.* 22: 124, 1936) first demonstrated the high relative biological effectiveness of neutrons in causing acute injury in mice and rats. During the ensuing years their findings have been confirmed by a number of investigators, but discrepancies have also been reported.

Improvements in methods of dosimetry now enable more precise evaluation of the physical events occurring during neutron irradiation. Thus, in the present report, the observed biological effect is related not only to the total dose (in ergs per gram of tissue) of neutrons and γ -rays but also, so far as possible, to the microscopic distribution of the ionization, or linear energy transfer (LET) as proposed by Zirkle (*J. Cellular Comp. Physiol.* 39: 75, 1952). This is of fundamental importance in understanding the mechanisms of radiation injury and may be of practical value in the fields of radiation protection and health physics.

Young adult female RF mice were exposed to single doses of Co^{60} γ -rays (1.17 to 1.33 MEV), 250-kvp x-rays (h.v.l. 0.55 mm. Cu), or cyclotron fast neutrons. The LD 50/30 days was found to be 730 rep for γ -rays, 528 rep for x-rays, and 362 rep for fast neutrons. If the relative biological effectiveness (RBE) of γ -rays is assumed to be 1.0, then the RBE of x-rays is 1.4 and that of fast neutrons 2.0 for LD 50/30 days.

Six figures; 7 tables.

The Effects of Total-Body Fast Neutron Irradiation in Dogs. V. P. Bond, R. E. Carter, J. S. Robertson, P. H. Seymour, and H. H. Hechter. *Radiation Res.* 4: 139-153, February 1956. (V. P. B., Medical Department, Brookhaven National Laboratory, Upton, Long Island, N. Y.)

The authors studied the acute effects produced in the dog by total-body fast neutron irradiation and compared these effects with those of 250-kvp. x-irradiation.

Signs of illness, survival time, hematological change, and gross and microscopic pathology in the dog were found to be essentially identical after acute total-body neutron and x-irradiation. No gross qualitative difference in effect on the dog for the two radiations appears to exist. The authors point out, however, that in their investigation massive doses were used, and only decedents were autopsied. It is possible that differences might be apparent at lower doses.

The ratio of LD 50 values for x- and fast neutron irradiation, with the dose taken as rep to the median sagittal plane of the animal, was 0.8.

Depth-dose studies for neutron and x-radiation indicated that, with bilateral exposure, the distribution of dose throughout the thickness of the dog was uniform and essentially identical for the two radiations.

Nine figures; 4 tables.

Cyclotron Neutron and γ -Ray Dosimetry for Animal Irradiation Studies. E. Tochilin, S. W. Ross, B. W. Shumway, G. D. Kohler, and R. Golden. *Radiation Res.* 4: 158-174, February 1956. (U. S. Naval Radiological Defense Laboratory, San Francisco, Calif.)

In an extensive animal irradiation program using the University of California 60-inch cyclotron of the Crocker Laboratory, a wide variety of biological endpoints were investigated. These included spleen and thymus weight loss, gut weight loss, mortality, hematologic effects, and preprotection studies (see U. S. Naval Radiological Defense Laboratory Report TR-20, 1954, and preceding abstract). Paralleling these studies was a dosimetry program designed to obtain an accurate description of the radiation fields encountered. The present paper is concerned with a description of the alternate dosimetry technic, namely, one of measuring the neutron flux density and spectrum of the radiation field and calculating the rep dose. The measuring techniques are somewhat different from those normally employed in radiation dosimetry and are more closely related to nuclear physics investigations. For details, the original paper should be consulted.

Eight figures; 3 tables.

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